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THE HEATING AND VENTILATING MAGAZINE

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Utilizing the Heat in a Pound of Coal

An Analysis of the Relation between Heating and Mechanical Equipment from a Fuel Standpoint.

By HAROLD L. ALT

The time has come when heating and ventilating must be considered on a broader basis and more in its relation to the other equipment in a building with which it must be associated. To carry out the nation-wide movement for conservation and economy it is necessary to produce the maximum amount of service out of a pound of coal and, while this object has always been the goal of all good engineers, it is doubtful if some of the specialists have taken into consideration the service performed, or which can be performed by a pound of coal outside the limitations of their concentrated activities.

How much and what can a pound of coal be made to do and is it being utilized to its full extent in existing and proposed installations? To consider this question intelligently it is necessary to review the cycle through which heat—formed by the combustion of fuel—passes in the process of utilizing its liberated energy to the utmost practical limit.

In the first place the pound of coal is thrown into the boiler furnace and is there burned, delivering—if proper conditions of combustion are provided—all of its energy in the form of heat. Part of this heat is radiated into the ash pit and the surrounding atmosphere, part is used in raising the fresh cold air supply up to the temperature of the gases of combustion, and part passes off and up the stack there producing all or part of the required draft; the larger portion, however, is absorbed into the water in the boiler and evaporates a certain quantity of the water into steam.

The steam then leaves the boiler and if it is to be used most effectively this steam will be generated at high pressure and will not enter the heating system direct, but, instead, will be utilized for some power-producing apparatus, such as an engine, pump, turbine, etc. After leaving such devices the exhaust, while having lost its high pressure, still possesses much of its original heat energy and may be turned into a heating system and the remaining heat utilized. In fact, some of the oldest engineers whose experience has been the largest, claim that the same building can be heated to the same degree with a fewer number of pounds of exhaust steam than with live steam. If this contention is true then the utilization of steam for power purposes is an actual heating economy exclusive of the gain made on the power end.

But, while the exhaust may be condensed and used in the heating system during the winter, this does not provide for a profitable employment of the same exhaust during the summer months and this has always been somewhat of a deterring factor when the proposal to use steam units throughout an installation has been considered. Modern progress, however, has now come to the rescue and for the summer months has evolved a most essential and desirable use for this surplus in the shape of exhaust steam refrigeration by the absorption system.

In this system the ammonia is driven out of the aqua ammonia contained in the ammonia boiler by interior coils into which the exhaust steam is admitted. The ammonia vaporizes, due to the heat of the steam, and generates a very high pressure; under these conditions it is cooled and condensed in a condenser after which it is ready for use in cooling coils either of the direct-expansion type or through a brine-circulating system.

PERCENTAGE OF HEAT USED IN REFRIGERATING SYSTEM.

But what are the proportions existing in such an installation and what percentage of the energy of the pound of coal finally reaches the refrigerating system and makes its appearance in the shape of a solid cake of ice?

In reference to this the graphic chart shown in Fig. 1 is particularly interesting. Here a per cent scale at the top indicates the percentage of total heat in the coal while the black lines indicate graphically the percentage of heat at various stages by their length; the hollow extensions on the black lines indicate the amount of loss occurring in the step listed at the left.

Thus, the first line at the top indicates the heat produced by the combustion of the coal, this being taken as 100%; the next line indicates the amount of heat left after the stack loss of 21% (indicated by the hollow extension on the right) is deducted; the next line indicates the amount of heat left after deducting the 7% ash pit and radiation losses, this being the amount of heat delivered into the water and going to form steam. After this is indicated a 2% loss occurring in the piping between the boiler and the apparatus in which the steam is used for power; the next line indicates the amount of heat so delivered, or about 70%, and the next the amount used or about 10%; after this is shown the amount of heat in the exhaust or about 60%, all of which formerly must have been entirely wasted during the summer months. In the winter this could have been utilized at 100% efficiency for heating, but unless absorption refrigeration is resorted to in the summer 60% of the pound of coal will have to be wasted during the summer months which is half the time or an average of 30% for the entire year.

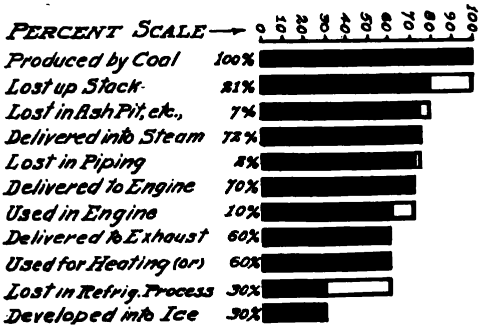


FIG. 1—PERCENTAGE OF HEAT USED IN REFRIGERATING SYSTEM.

There is considerable loss in the refrigeration equipment due to absorption of heat during the hot weather so that only about 50% efficiency of the apparatus is obtainable, but even at 50% the 60% of the heat in the pound of coal will give a utilization of 30% which appears in the form of ice, or about 33%, if refrigeration without ice is used.

GRAPHIC CHART BASED ON AVERAGES ONLY

On the chart only average percentages obtained under normal operating conditions are shown and probably no single plant would follow these percentages all the way through, although it might approximate them. The fallacy of expecting exactness in such a general statement can be seen from the fact of the great variation in steam consumed per I. H. P. of various types of standard engines and pumps on the market today.

For instance—one engine will require per I. H. P. hour on

Triple expansion engines	11 to 14	lbs. of steam
Compound engines	12 to 15	" " "
Simple, condensing engines	17 to 20	" " "
Simple, non-condensing jacketed engines	18 to 22	" " "
Simple, non-condensing unjacketed engines	24 to 35	" " "
Piston and plunger pumps	60 to 200	" " "

The graphic chart therefore is based on averages only and must not be too closely criticised. It gives a good idea, however, of the heat efficiencies and losses of the pound of coal.

For example—a certain engine requires 20 lbs. of steam per horsepower at 70 lbs. gauge and, if the mechanical equivalent of heat is 2545 B. T. U., per horse-power, then it is very easy to compute the heat efficiency of the engine, since each pound of steam at 70 lbs. gauge contains 1116 B. T. U. Then the input is 1116 B. T. U. × 20 and the developed I. H. P. or 2545 B. T. U. and 2545/1116 × 20 = 11.4% used in the engine. At 30 lbs. per I. H. P. 7.6% would be used and at 15 lbs. 15%.

All of which leads to the point where the uselessness is perceived of trying to establish any practical relation between the boiler and engine horsepower. Of course there *is* a theoretical relation since both may be reduced to B. T. U. If the quantity, pressure and temperature of the steam entering an engine is measured and the temperature, pressure and quantity of the exhaust is noted it is self-evident that both can be reduced to B. T. U. and the difference between be assigned as engine losses and as utilized in the production of work. But there is no connection between this and a boiler horsepower.

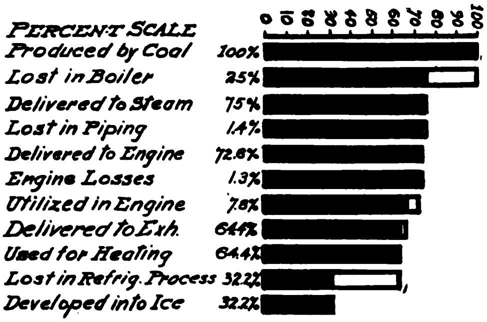


FIG. 2—HEAT LOSSES AND UTILIZATIONS FOR A SINGLE-CYLINDER ENGINE.

According to the accepted definition of a boiler horsepower it consists of the evaporation of 30 lbs. of water from a temperature of 100° F. into steam at 70 lbs. gauge or the equivalent of evaporating $34\frac{1}{2}$ lbs. of water from and at 212° F. into steam at atmospheric pressure. This requires

$$34.5 \times 970.4 = 33{,}479 \text{ B. T. U.}$$

Someone recently discovered that this was a trifle over thirteen times as much as an engine horsepower by the following reasoning:

1 foot pound = 778 B. T. U.
1 engine H. P. = 33,000 ft. lbs. per min.
1 engine H. P. hour = 33,000 × 60 = 1,980,000 ft. lbs.
1,980,000/778 = 2,545 B. T. U. per engine horsepower.
33,479/2545 = 13.1 +

This relation is authentic but of little use.

It is much more essential to know the

distribution of the B. T. U. in a pound of coal, these being divided up about as follows, assuming 14,000 B. T. U. per pound of coal burned.

(a) B.T.U. developed in burning 1 lb. of coal....14,000 × 100% = 14,000
(b) B.T.U. lost up stack........................14,000 × 21% = 2,940
(c) B.T.U. lost in ash-pit and radiated..........14,000 × 7% = 980
(d) B.T.U. lost in piping.......................14,000 × 2% = 280
(e) B.T.U. used in engine.......................14,000 × 10% = 1,400
(f) B.T.U. left in exhaust.......................14,000 × 60% = 8,400
(g) B.T.U. utilized in heating system (or).........14,000 × 60% = 8,400
(gg) B.T.U. lost in refrigeration plant............14,000 × 30% = 4,200
(gg) B.T.U. incorporated into ice..............14,000 × 30% = 4,200

From this it can readily be seen how many B. T. U. per pound of fuel are available at any point and how many can be utilized under common operating conditions.

ADVANTAGE OF RUNNING BOILERS ABOVE RATED CAPACITY

It is well known that a boiler operated under high pressure will produce steam to a large extent depending upon the grate area and intensity of draft rather than on the heating surface. In fact many corporations make it a regular practice to run their boilers at 100% overload or 200% rating. On this basis a nominal boiler horsepower may produce anywhere from 30 to 60 lbs. of steam per hour according to the degree of overload and an engine may consume anywhere from 11 to 35 lbs. of steam per engine horsepower. The uselessness of trying to establish a practical relation between two such variables is apparent and the old catalogue phrase that "one boiler-horsepower equals two engine horsepower" should be forgotten once and for all.

HEAT PERCENTAGE CHART FOR VARIOUS TYPES OF PRIME MOVERS

The distribution of the B. T. U. in a pound of coal is even more interesting when considered for special cases. For instance the heat losses and utilizations for a single-cylinder engine in which the exhaust is utilized for heating are shown in Fig. 2. In this graphic analysis 25% of the B. T. U. is lost in the boiler, 1.4% in the piping to the engine, 1.3% loss in the engine and 7.8% utilized for work, with 64.4% left for heating or refrigeration work.

In Fig. 3 is shown the results obtained from a steam turbine where the total B.T.U. generated loses 25% in the boiler, 1.37% in the piping to the turbine, 0.53% radiation from the turbine, has 4.38% transformed into work, leaving 68.72% for heating or refrigeration.

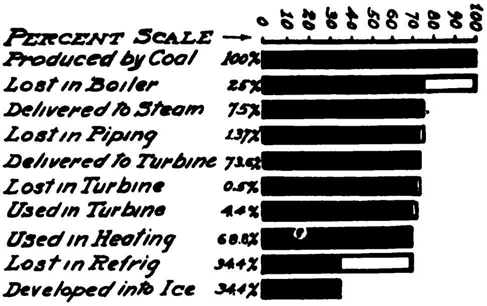


FIG. 3—RESULTS OBTAINED FROM A STEAM TURBINE.

In Fig. 4 is shown the result from a tandem compound engine, run condensing. Here it is seen that the boiler loss is 25%, piping 1.3%, condensation in engine 2.5% transformed into work 11.8%. The balance is carried off in the condensing water, leaving no exhaust for heating or other uses, this resulting in a dead loss of 59.4%. Thus the most efficient engine is not by any means the most economical when considered from the pound of coal standpont for to supply a heating system with this engine there must be used a heating plant, or else additional high-pressure steam must be taken from the boilers

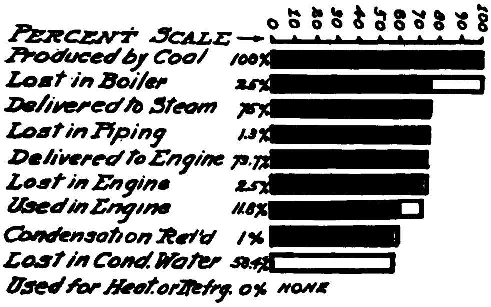


FIG. 4—RESULT FROM TANDEM COMPOUND ENGINE, RUN CONDENSING.

and injected into the heating system through a reducing valve.

The diagram for the heating plant is shown in Fig. 5. Here of the 100% developed 25% is lost in the boiler and 75% is delivered into the steam for heating or refrigeration use. If, in Fig. 4, the exhaust had been utilized, instead of being condensed, 59% of every pound of coal burned under the power boilers for power would have been available for heating or refrigeration use.

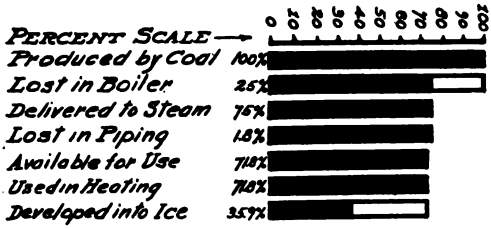


FIG 5—DIAGRAM FOR HEATING PLANT.

How Much Do You Pay for the Water on Coal?

By W. F. Schaphorst.

It is a common practice for coal dealers to "wet down" the coal they sell for the purpose of laying the dust. Water, however, is rather "heavy stuff." It takes but 32 cu. ft. of it to make a ton. At the present high cost of coal and its trend upward, the cost of water is, therefore, going up also.

How much water will cling to coal is, of course, uncertain. 10 lbs. might be the limit with smooth, hard, large-lump anthracite. Anthracite, however, does not need wetting as much as bituminous and the softer coals. Fine soft coal will doubtless absorb 100 lbs. of water per ton. Coal dust will, perhaps, absorb its own weight in water.

For example, let us assume that after being wetted down, a ton of coal, as sold, is actually 1,900 lbs. coal and 100 lbs. water and that the dealer's price is $4.00 per ton. What is the actual price per ton?

The method of computing this can be put in the form of a formula:

$$\frac{2{,}000}{2{,}000 - W} \times P = A$$

where A is the actual price per ton W, the weight of water per 2,000 lbs.

P, dealer's price per ton.

Substitute in this formula and you will find the actual price in the above problem to be $4.21 per ton.

That, however, is not all. There is another loss, the cost of evaporating the 100 lbs. of water in the furnace. Although not so great, it is a loss that is worth considering, where much coal is purchased. In direct contact with the flames, with no intermediate iron shell to diminish efficiency, a pound of coal should evaporate at least 10 lbs. of water. Ten pounds of coal would, therefore, be required to evaporate the above 100 lbs. of water, which leaves but 1,890 lbs. of "effective coal" per 2,000 lbs.

Substituting in the above formula we get $4.23 as the actual cost per ton. Considering this loss, in addition to the first loss, the formula becomes:

$$\frac{2{,}000}{2{,}000 - 1.1\ W} \times P = A$$

Although 23 cents per ton may not sound like much, it is easy to see that when selling 100 tons per day the coal dealer can easily make $23.00 on "watered stock."

CHICAGO COMMISSION ON VENTILATION

Ventilation Test of the Lewis-Champlin School

II

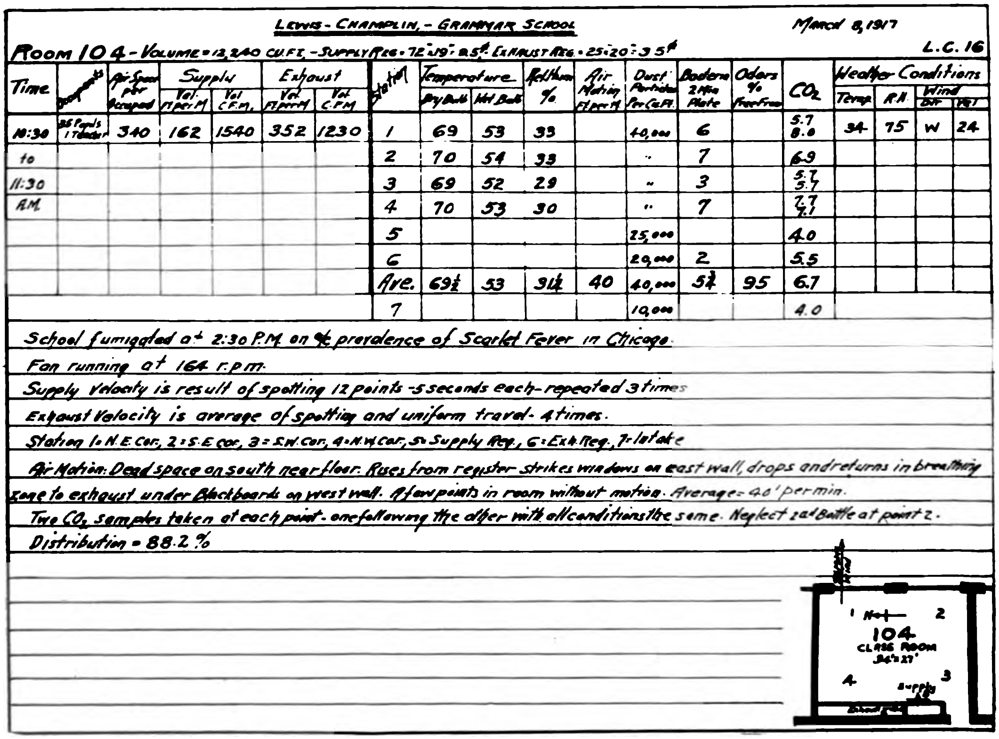
Edited by **SAMUEL R. LEWIS.**

(*Continued from December Issue*)

Room No. 104.

MARCH 8, 1917

1. The amount of air delivered for each occupant was 42 cu. ft. per minute. 310 cu. ft. per minute were leaving the room at other points than at the exhaust. This is characteristic of a plenum system for a room on the leeward side. The location of supply and exhaust openings with reference to each other and the exposed surfaces, is supposedly fortunate, since both are on an interior wall, opposite the cold exposure. All of the operating conditions were presumably normal. The fan was running at slightly above the calculated speed. The distribution was fair, as evidenced by the CO_2



LEWIS - CHAMPLIN, - GRAMMAR SCHOOL March 8, 1917

ROOM 104 - VOLUME = 12,240 CU.FT. - SUPPLY REG. = 72"×19" = 9.5 sq. ft. EXHAUST REG. = 25×20 = 3.5 sq. ft. L.C. 16

Time	Occupants	Air Space per Occupant	Supply		Exhaust		Station	Temperature		Rel. Hum. %	Air Motion Ft. per M.	Dust Particles Per Cu. Ft.	Bacteria 2 Min Plate	Odors % Free From	CO_2	Weather Conditions			
			Vel. Ft. per M.	Vol. C.F.M.	Vel. Ft. per M.	Vol. C.F.M.		Dry Bulb	Wet Bulb							Temp.	R.H.	Wind Dir.	Wind Vel.
10:30	35 Pupils 1 Teacher	340	162	1540	352	1230	1	69	53	33		40,000	6		5.7 8.0	34	75	W	24
to							2	70	54	33		"	7		6.9				
11:30							3	69	52	29		"	3		5.7 5.7				
A.M.							4	70	53	30		"	7		7.7 7.1				
							5					25,000			4.0				
							6					20,000	2		5.5				
							Ave.	69½	53	31½	40	40,000	5¾	95	6.7				
							7					10,000			4.0				

School fumigated at 2:30 P.M. on a/c prevalence of Scarlet Fever in Chicago.

Fan running at 164 r.p.m.

Supply Velocity is result of spotting 12 points - 5 seconds each - repeated 3 times

Exhaust Velocity is average of spotting and uniform travel - 4 times.

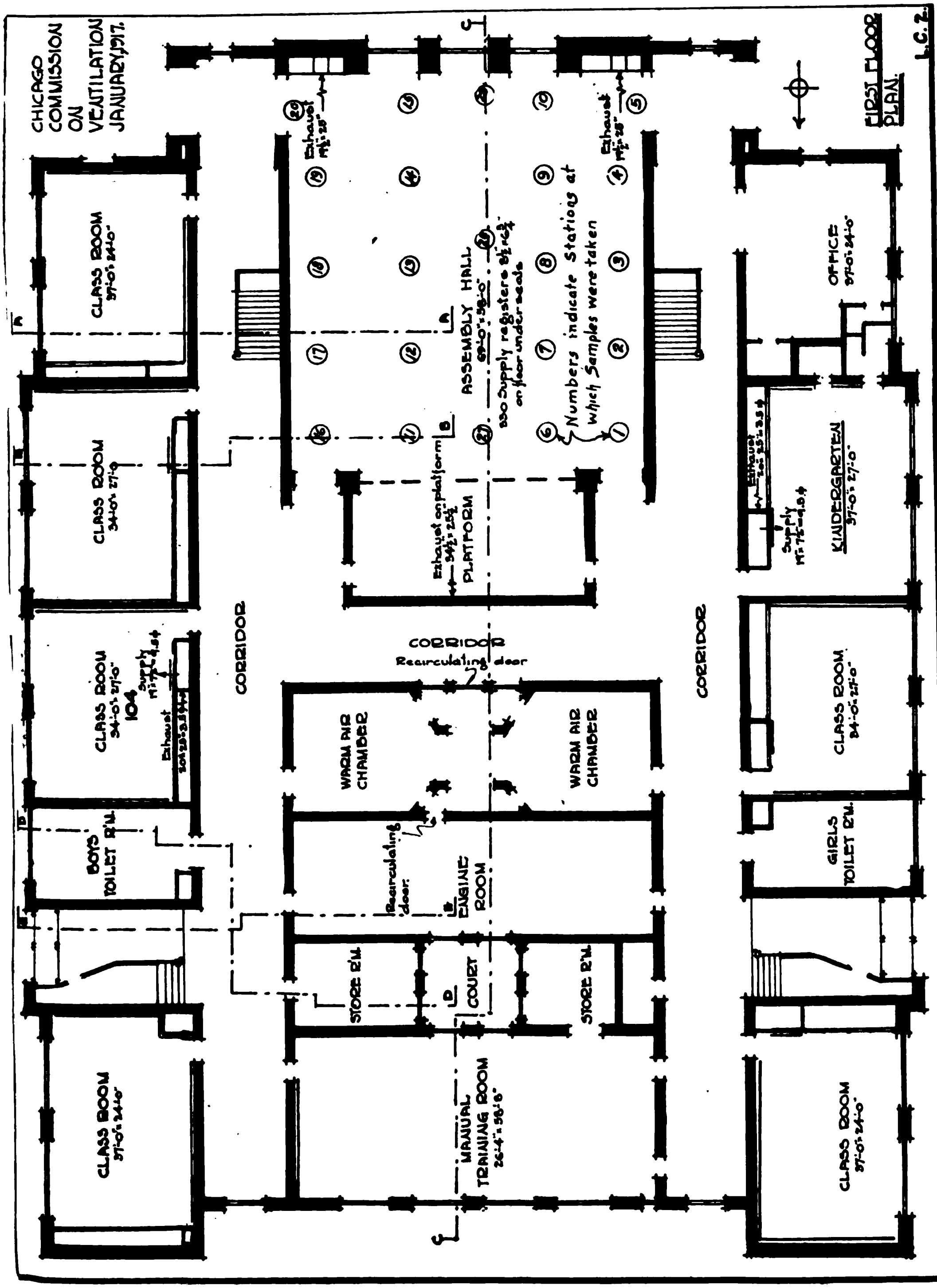
Station 1 = N.E. Cor., 2 = S.E. Cor., 3 = S.W. Cor., 4 = N.W. Cor., 5 = Supply Reg., 6 = Exh. Reg., 7 = Intake

Air Motion: Dead space on south near floor. Rises from register - strikes windows on east wall, drops and returns in breathing zone to exhaust under Blackboards on west wall. A few points in room without motion. Average = 40' per min.

Two CO_2 samples taken at each point - one following the other with all conditions the same. Neglect 2nd Bottle at point 2.

Distribution = 88.2 %

TEST DATA FOR ROOM 104, LEWIS-CHAMPLIN SCHOOL.


CHICAGO COMMISSION ON VENTILATION JANUARY, 1917.
FIRST FLOOR PLAN.
L.C.Z.
CLASS ROOM 37'-0" x 24'-0"
CLASS ROOM 34'-0" x 27'-0"
CLASS ROOM 104 34'-0" x 27'-0"
Supply
Exhaust
BOYS TOILET R'M.
CLASS ROOM 37'-0" x 24'-0"
CORRIDOR
ASSEMBLY HALL 69'-0" x 58'-0"
330 Supply registers 8½ x 6¾ on floor under seats
Numbers indicate Stations at which Samples were taken
Exhaust
Exhaust on platform
PLATFORM
CORRIDOR
Recirculating door
WARM AIR CHAMBER
WARM AIR CHAMBER
Recirculating door
ENGINE ROOM
STORE R'M.
COURT
STORE R'M.
MANUAL TRAINING ROOM 26'-4" x 58'-6"
CORRIDOR
OFFICE 37'-0" x 24'-0"
Exhaust
Supply
KINDERGARTEN 37'-0" x 27'-0"
CLASS ROOM 34'-0" x 27'-0"
GIRLS TOILET R'M.
CLASS ROOM 37'-0" x 24'-0"
A
B
C
D

FIRST FLOOR PLAN, LEWIS-CHAMPLIN SCHOOL.

observations. There was evidently a circular motion of the entire room air content, starting at the supply opening and gradually dropping toward the floor as the cooling influence became manifest. Thus, the CO_2 was higher at station 4 than at station 6. A quiet air space was observed between stations 2 and 3 under the blast of air from the supply opening. There was, at least, no objection to the motion observed. Some objection to the lack of motion might fairly be raised at certain points in the room.

2. The temperatures were excellent, and are supported by other observations of January 9, 10, 12 and 15, 1917. The temperature at the floor, near the outside wall was generally around five degrees cooler than the temperature in the center of the room, four feet above the floor. As there is no basement under the first floor, some justification is evident of the complaint by the teacher of a cold floor. It may be overcome, however, by heating the room for a longer time prior to occupancy.

3. The moisture content was 10% too low, according to the temperature, since with a 70° dry bulb, a 40% relative humidity is most comfortable.

4. The dust content was very high, both as compared with other rooms and with that outside. Much of it seemed to be in suspension in the room, and as the amount at the exhaust was less than that in the samples from the stations in the room, some local condition, such as recent agitation, perhaps by movement of the pupils, must be responsible. It is doubtful if the dust count of March 8 in room 104 means anything especially serious. Chalk dust was doubtless present, though all reasonable precautions were taken to present it.

5. The bacteria colonies in room 104 as compared with other rooms are rather low. They are strikingly low at station 3, under the supply. The same condition was noted January 9.

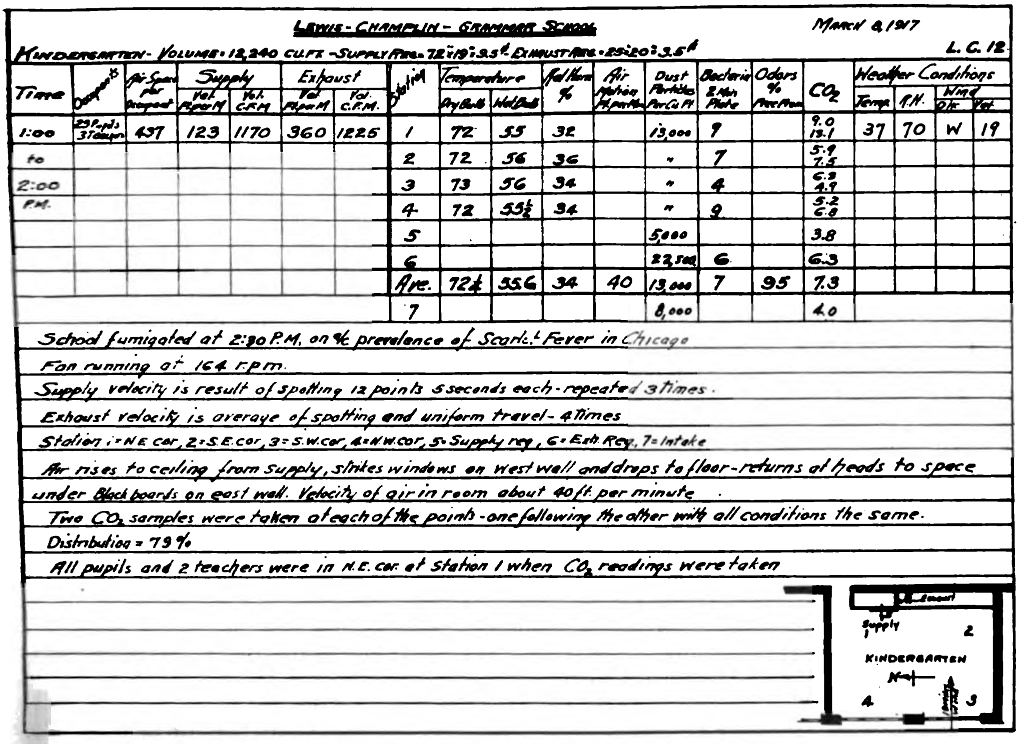
Kindergarten

March 8, 1917

1. The amount of air delivered for each occupant was 41 cu. ft. per minute. Slightly more air was leaving the room at the exhaust than was entering at the supply opening, indicating inward leakage, probably through the outside wall. This is checked by the fact that the wind was from the west. The same relation of supply and exhaust openings is in effect as in room 104. As observed, the air distribution was very smilar to room 104. The occupants were at station 1 when the CO_2 readings were taken, and the latter testify strikingly to this.

KINDERGARTEN, LEWIS-CHAMPLIN SCHOOL.

2. The room was too warm and this fact, together with the observations of January 9, indicate some improper air supply condition affecting the temperature, or poorly adjusted thermostats. Since the moisture content is fixed by the regulating instrument in another room, the temperature should be kept lower than 72, which is very close to the upper margin of the "comfort zone." The teachers have a tendency frequently (about every half hour) to open the windows. The thermostat may be set unduly high so as more quickly to compensate for this.



LEWIS-CHAMPLIN-GRAMMAR SCHOOL

MARCH 8, 1917

KINDERGARTEN- VOLUME=12,240 CU.FT.-SUPPLY REG.=72"×19"=9.5□'-EXHAUST REG.=25"×20"=3.5□'

L. C. 12

Time	Occupants	Air Space per Occupant	Supply Vel. Ft per M	Supply Vol. C.F.M.	Exhaust Vel Ft per M	Exhaust Vol. C.F.M.	Station	Temperature Dry Bulb	Temperature Wet Bulb	Rel Hum %	Air Motion Ft per Min	Dust Particles Per Cu Ft	Bacteria 2 Min Plate	Odors % Free From	CO2	Weather Conditions Temp	Weather Conditions R.H.	Wind Dir	Wind Vel
1:00	29 Pupils 3 Teachers	437	123	1170	360	1225	1	72	55	32		13,000	9		9.0 13.1	37	70	W	19
to							2	72	56	36		"	7		5.9 7.5				
2:00							3	73	56	34		"	4		6.3 4.9				
P.M.							4	72	55½	34		"	9		5.2 6.8				
							5					5,000			3.8				
							6					22,500	6		6.3				
							Ave.	72¼	55.6	34	40	13,000	7	95	7.3				
							7					8,000			4.0				

School fumigated at 2:30 P.M. on a/c prevalence of Scarlet Fever in Chicago

Fan running at 164 r.p.m.

Supply velocity is result of spotting 12 points 5 seconds each-repeated 3 times.

Exhaust velocity is average of spotting and uniform travel-4 times

Station 1=N.E. cor., 2=S.E. cor., 3=S.W. cor., 4=N.W. cor., 5=Supply reg., 6=Exh. Reg., 7=Intake

Air rises to ceiling from supply, strikes windows on west wall and drops to floor-returns at heads to space under Blackboards on east wall. Velocity of air in room about 40 ft. per minute.

Two CO_2 samples were taken at each of the points-one following the other with all conditions the same.

Distribution = 79%

All pupils and 2 teachers were in N.E. cor. at Station 1 when CO_2 readings were taken

TEST DATA FOR KINDERGARTEN.

3. The humidity checks fairly well with that of room 104. Some variation is accountable, since the moisture in the two sides of the building is supplied by different steam jets.

4. Very much less dust seems to be evident than in 104, and the relation borne by that in the room to that in the exhaust seems more logical. Tests made in January in this room indicated that the dust content increased about 25% when the occupants were running and jumping.

5. We do not observe any particular significance in the bacteria count, except that the bacteria followed the crowd and increased at station 1, while in 104 the corresponding point, not especially occupied was lowest in bacteria.

Room No. 201, and Check Test on Room No. 301.

1. Room 201 was tested in January, on March 9, and again on March 28. We show the test of March 28.

Each occupant was receiving 26 cu. ft. of air per minute. Although this room was on the windward side, the breeze did not overcome the fan pressure and 390 cu. ft. per minute were leaving the room elsewhere than at the exhaust. The location of supply and exhaust openings with reference to each other and the cooling surface is very different to that in effect in room 104. The supply is delivered in a direction parallel with the glass, and the exhaust is on the opposite side of the room along an outside wall. The cubic feet of space per occupant was 280, as compared with 340 for 104. The fan speed was but 2 R. P. M. slower than when 104 was tested.

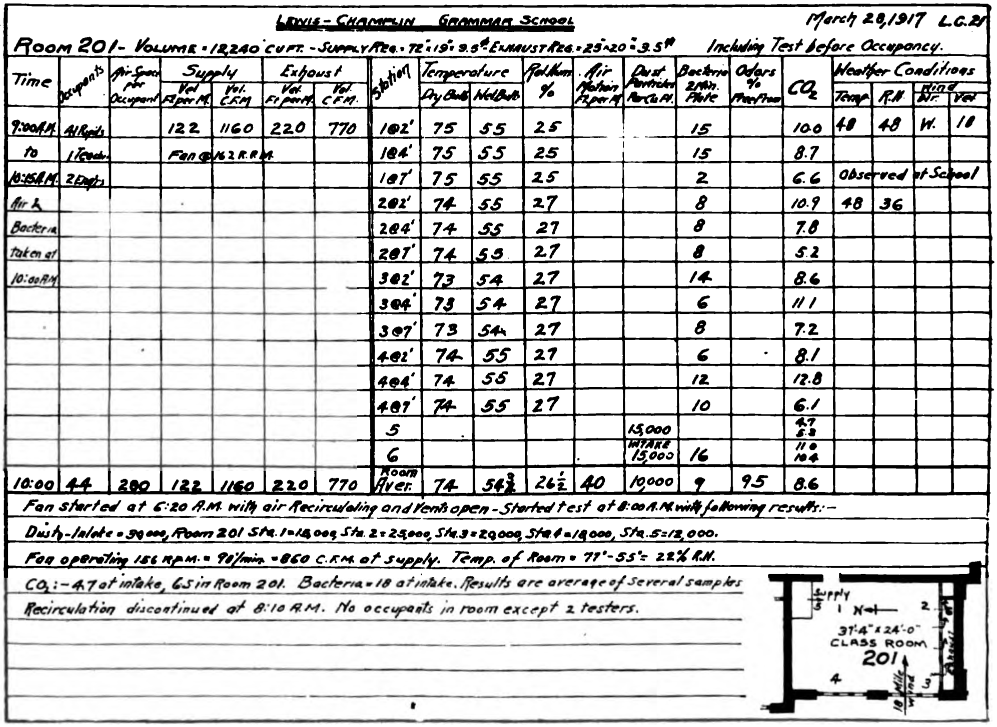
The rather high average of CO_2 in the room (8.6) proves the anemometer observation of a deficient volume of fresh air. Contrary to the expectations of some of us, the CO_2 content was very evenly proportioned at the four stations (at one 8.4; at two 7.9; at three 8.9; and at four 9 parts). The average CO_2 at the four stations was—at 2 ft. above the floor—9.4; at 4 ft. above the floor, 10.1; and at 7 ft. above floor, 6.3 parts. While the highest CO_2 at stations 1 and 2 was at 2 ft. above the floor, the highest at stations 3 and 4 was at 4 ft. above the floor.

As was expected, the whirling effect of the entire room contents, due to the location of the supply, caused a slightly higher CO_2 content at station 4. The test indicates that the stratum of contaminated air 4 ft. above the floor at station 4, is encountered at station 1 about 2 ft. lower down, on its corkscrew-like journey to the exhaust. Room 301 is directly over room 201, and is identical with it in arrangement. No flat comparison can be made, because of the difference in the number of occupants. Fresh air was being delivered at the rate of over 38 cu. ft. per occupant per minute, and each occupant had 355 cu. ft. of air space. The results, however, show very good distribution, with the corkscrew effect well marked, and nothing in any of the tests shows any reason, so far as air distribution is concerned, for criticising the plan of these rooms.

2. The tendency in both rooms on March 28 was to keep them unduly warm, with a low relative humidity. The tendency shown in all of the tests was to maintain room 201 at unduly high temperature.

3. It will be noticed that the outside relative humidity was but 36% as observed at the school; on March 9, with 60% relative humidity outside, room 201 was at 74° dry bulb, and 26% relative humidity.

4. The dust observations do not convey any particular information, except that they indicate some not unexpected


Supply
3
1
2
31'-4" x 24'-0"
CLASS ROOM
201
4
3
Exhaust
10 Mile wind

LEWIS-CHAMPLIN GRAMMAR SCHOOL — March 28, 1917 — L.C.21

Room 201 - Volume = 12,240 cu. ft. - Supply Reg. = 72" × 19" = 9.5□' Exhaust Reg. = 25" × 20" = 3.5□' Including Test before Occupancy.

Time	Occupants	Air Space per Occupant	Supply		Exhaust		Station	Temperature		Rel. Hum. %	Air Motion Ft. per M.	Dust Particles Per Cu. Ft.	Bacteria 2 Min. Plate	Odors % Free from	CO_2	Weather Conditions			
			Vel. Ft. per M.	Vol. C.F.M.	Vel. Ft. per M.	Vol. C.F.M.		Dry Bulb	Wet Bulb							Temp.	R.H.	Wind Dir.	Wind Vel.
9:00 A.M.	41 Pupils		122	1160	220	770	1@2'	75	55	25			15		10.0	48	48	W.	10
to	1 Teacher		Fan @ 162 R.P.M.				1@4'	75	55	25			15		8.7				
10:15 A.M.	2 Experts						1@7'	75	55	25			2		6.6	Observed at School			
Air &							2@2'	74	55	27			8		10.9	48	36		
Bacteria							2@4'	74	55	27			8		7.8				
taken at							2@7'	74	55	27			8		5.2				
10:00 A.M.							3@2'	73	54	27			14		8.6				
							3@4'	73	54	27			6		11.1				
							3@7'	73	54	27			8		7.2				
							4@2'	74	55	27			6		8.1				
							4@4'	74	55	27			12		12.8				
							4@7'	74	55	27			10		6.1				
							5					15,000			4.7 5.3				
							6					INTAKE 15,000	16		11.0 10.4				
10:00	44	280	122	1160	220	770	Room Aver.	74	54⅜	26½	40	10,000	9	95	8.6				

Fan started at 6:20 A.M. with air Recirculating and Vents open - Started test at 8:00 A.M. with following results:-

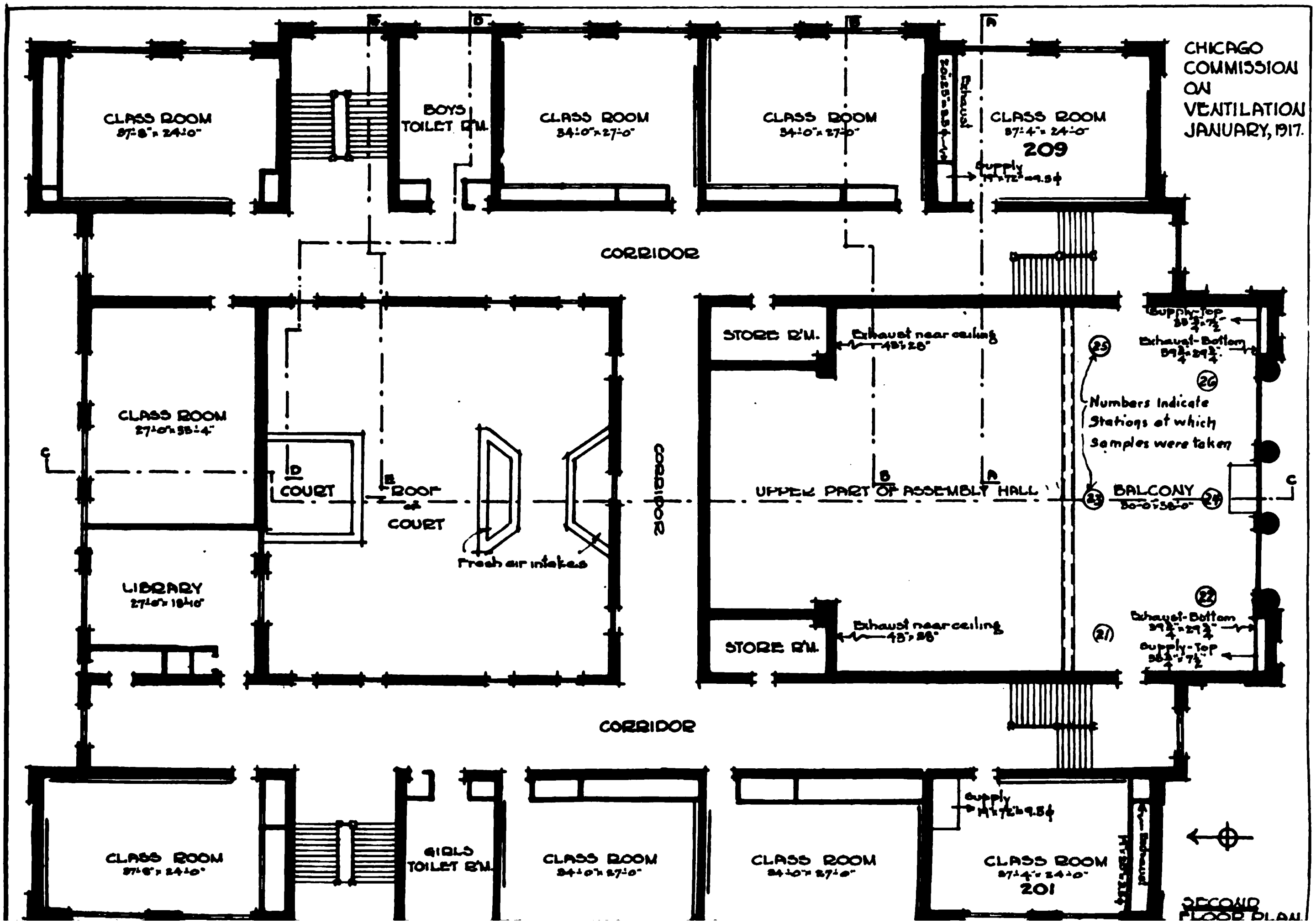
Dust - Intake = 90,000, Room 201 Sta. 1 = 18,000, Sta. 2 = 25,000, Sta. 3 = 20,000, Sta. 4 = 18,000, Sta. 5 = 12,000.

Fan operating 156 R.P.M. = 90'/min. = 860 C.F.M. of supply. Temp. of Room = 77°-55° = 22% R.H.

CO_2:- 4.7 at intake, 6.5 in Room 201. Bacteria = 18 at intake. Results are average of several samples

Recirculation discontinued at 8:10 A.M. No occupants in room except 2 testers.

TEST DATA FOR ROOM 201.



SECOND FLOOR PLAN, LEWIS-CHAMPLIN SCHOOL.

variations, possibly due to sudden wind flurries at the intake. Some settling out of the dust into the long horizontal basement duct would be expected, since room 201 has one of the longest ducts, but such settlement was not indicated by the tests.

5. The bacteria colonies seem to check fairly well with the CO_2 observations. Note particularly the low count at station 1, seven feet above the floor, and the high count two feet above the floor. It indcates that in its circular movement around the room, the incoming air is diluted by contaminated air even at the 7-foot height, when it reaches station 4.

Room No. 209.

March 9, 1917.

1. The amount of air delivery per occupant was 30 cu. ft. per minute. 330 c. ft. per minute were leaving elsewhere than at the exhaust, indicating an outward lee-side leakage of about one-fourth of the supply. The location of the supply and exhaust openings is the same with reference to the glass surface as in 201, but the exhaust is on the same side of the room as the supply. The fan was running at 10 B. P. M. below the speed in effect when 104 was tested. All of the tests in the room seem to be consistent and in our judgment show the best results to be expected from this type of plant.

2. The temperature was too high, and the humidity too low. Compared with the observations of January, there is indicated a tendency in the colder weather of January to keep the tempered air chamber too warm.

3. More moisture and lower temperature would have been better.

4. The dust observations are consistent with 104 and suggest chalk dust,

LEWIS - CHAMPLIN - GRAMMAR SCHOOL MARCH 9, 1917

ROOM 209 - VOLUME = 12240 CU. FT. - SUPPLY REG. = 72" × 19" = 9.5# EXHAUST REG. = 25" × 20" = 3.5# L.C. 27

Time	Occupants	Air Space per Occupant	Supply		Exhaust		Station	Temperature		Rel. Hum.	Air Motion	Dust Particles	Bacteria 2 Min.	Odors %	CO2	Weather Conditions			
			Vel. Ft. per M.	Vol. C.F.M.	Vel. Ft. per M.	Vol. C.F.M.		Dry Bulb	Wet Bulb	%	Ft. per M.	Per Cu. Ft.	Plate	Free From		Temp.	R.H.	Wind Dir.	Wind Vel.
10:45	41 Pupils 1 Teacher	290	135	1280	272	950	1	70	52	27		51,000	6		6.8 8.0	35	60	S.W.	9
to							2	70	52	27		.	4		5.9				
11:15							3	70	52	27		.	8		5.3 5.8				
AM.							4	70	52	27		..	3		7.0 6.6				
							5					16,000			5.0				
							6					35,000	9		7.7				
							Ave.	70	52	27	40	51,000	5.2	90	6.45				
							7					14,000			4.2				

School was fumigated previous afternoon.

Fan running at 154 r.p.m.

Supply Velocity is result of spotting 12 points - 5 seconds each - repeated 3 times

Exhaust Velocity is average of spotting and uniform travel - 4 times

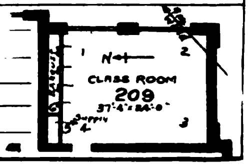
Station 1 = N.E. cor., 2 = S.E. cor., 3 = S.W. cor., 4 = N.W. cor., 5 = Supply Reg., 6 = Exh. Reg., 7 = Intake

Air Motion: Drops to heads in advancing on West side - returns at heads on east side

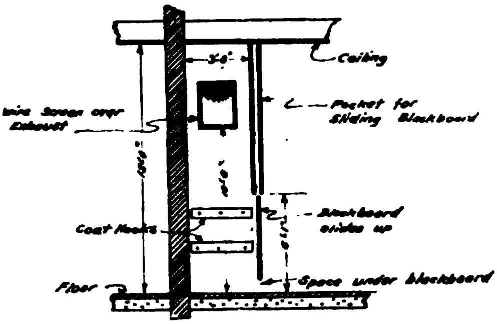
Two CO_2 samples taken at each point - one following the other, with all conditions the same - Neglect 2nd bottle at point 2.

Distribution = 90.3%

Dust in Room 209 was extremely fine on plates



TEST DATA FOR ROOM 209.



TYPICAL SECTION THROUGH WARDROBE, SHOWING METHOD OF EXHAUST VENTILATION.

or agitation by occupants. The number of dust particles and bacteria colonies apparently have no coordination.

5. The bacteria observations are consistent, and very interesting as compared with the results on the same day in 201, which is the same distance from the fan and which is symmetrical in every way with 209, except as to cubic feet of air supply per minute, per occupant, and as to relation of supply location to exhaust location. Room 201 had an average number of colonies three times as high as 209. The test of 201 of March 28 shows no such startling variation from 209. We cannot account for the difference, except perhaps because of recent movement within the room by the pupils.

Room No. 304.

MARCH 9, 1917.

1. The amount of air delivered per occupant was 44 cu. ft. per minute. 530 cu. ft. per minute were escaping elsewhere than at the exhaust and this against the light breeze. The relation of the supply and exhaust openings and the plan of the room duplicate room 209. No explanation is manifest for the poor showing as to CO_2 results, in a room the duplicate of 209, when each occupant was receiving nearly 50% more air per minute than 209. The effects of the adjacent old Lewis school may account for this. Possibly it may be that in 209 the occupants were in motion or had very recently been moving about, thus accounting for the tremendous dust count and the better dilution of the CO_2, while in 304 the dust shows low, with poor dilution, indicating that the occupants were quiet.

2. The temperature was satisfactory, but the relative humidity was too low. The tests of January indicate some tendency to overheat the tempered air, as mentioned before.

3. The relative humidity was reasonably consistent with the temperature. There is a strong indication that the temperature could not have been maintained much lower without increasing the humidity, and a probability that the limit of the moisture introducing apparatus had been reached.

4. There is strong evidence that the occupants were quiet, and that the blackboards were not being used.

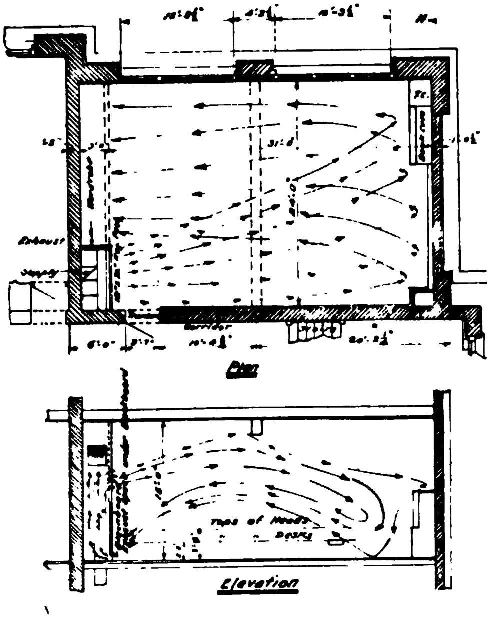


DIAGRAM OF AIR CURRENTS IN ROOM 209 AT TIME OF TEST.

LEWIS-CHAMPLIN — GRAMMAR SCHOOL MARCH 9, 1917

ROOM 304 - VOLUME = 12240 CU.FT. - SUPPLY REG = 72"×19" = 9.5# EXHAUST REG = 25"×20" = 3.5# L.C.32

Time	Occupants	Air Space per Occupant	Supply Vel. Ft. per M.	Supply Vol. C.F.M.	Exhaust Vel. Ft. per M.	Exhaust Vol. C.F.M.	Station	Temperature Dry Bulb	Temperature Wet Bulb	Rel. Hum. %	Air Motion Ft. per M.	Dust Particles Per Cu.Ft.	Bacteria 2 Min. Plate	Odors % Free From	CO₂	Weather Conditions Temp.	R.H.	Wind Dir.	Wind Vel.
1:00	36 Pupils 1 Teacher	330	172	1630	315	1100	1	68	53	35		11,000	9		5.7 6.4	40	65	S.W.	9
to							2	68	53	35		•	11		8.8 9.0				
1:50							3	68	53	35		•	3		8.6 9.3				
P.M.							4	68	53	35		•	13		7.2 6.3				
							5					5,000			6.2				
							6					7,000			6.5				
							Ave.	68	53	35	40	11,000		90	7.5				
							7	–				14,000			4.2				

School was fumigated previous afternoon

Fan running at 154 r.p.m.

Supply Velocity is result of spotting 12 points - 5 seconds each - repeated 3 times.

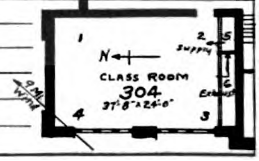
Exhaust Velocity is average of spotting and uniform travel - 4 times

Station 1 = N.E. cor., 2 = S.E. cor., 3 = S.W. cor., 4 = N.W. cor., 5 = Supply Reg., 6 = Exh. Reg., 7 = Intake.

Air Motion - Drops to heads on east side and rises - returns on west side at heads

Two CO_2 samples taken at each point - one following the other with all conditions the same.

Distribution = 86 %



TEST DATA FOR ROOM 304.

LEWIS-CHAMPLIN GRAMMAR SCHOOL MARCH 16, 1917

ROOM 305 VOLUME = 12,240 CU.FT. SUPPLY REG. = 72"×19" = 9.5# EXHAUST REG. 25"×20" = 3.5# L.C.41

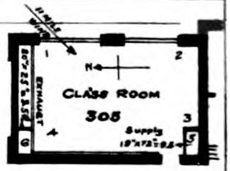
Time	Occupants	Air Space per Occupant	Supply Vel. Ft. per M.	Supply Vol. C.F.M.	Exhaust Vel. Ft. per M.	Exhaust Vol. C.F.M.	Station	Temperature Dry Bulb	Temperature Wet Bulb	Rel. Hum. %	Air Motion Ft. per M.	Dust Particles Per Cu.Ft.	Bacteria 2 Min. Plate	Odors % Free From	CO₂	Weather Conditions Temp.	R.H.	Wind Dir.	Wind Vel.
12:30	43 Pupils 1 Teacher	280	195	1850	340	1190	1	74	54	24½		11000	4		6.5	35	65	N.E.	11
to							2	73	53	23		•	7		10.8				
1:15							3	73½	53½	23		–	15		6.4				
							4	74	54	24½		Supply 6500	10		7.3				
							7	40	34	52					3.8				
							6					11000	10		5.4				
							Ave.	73.6	53.6	23¾	40	11000	9	85	7.75				

Fan running 164 r.p.m.

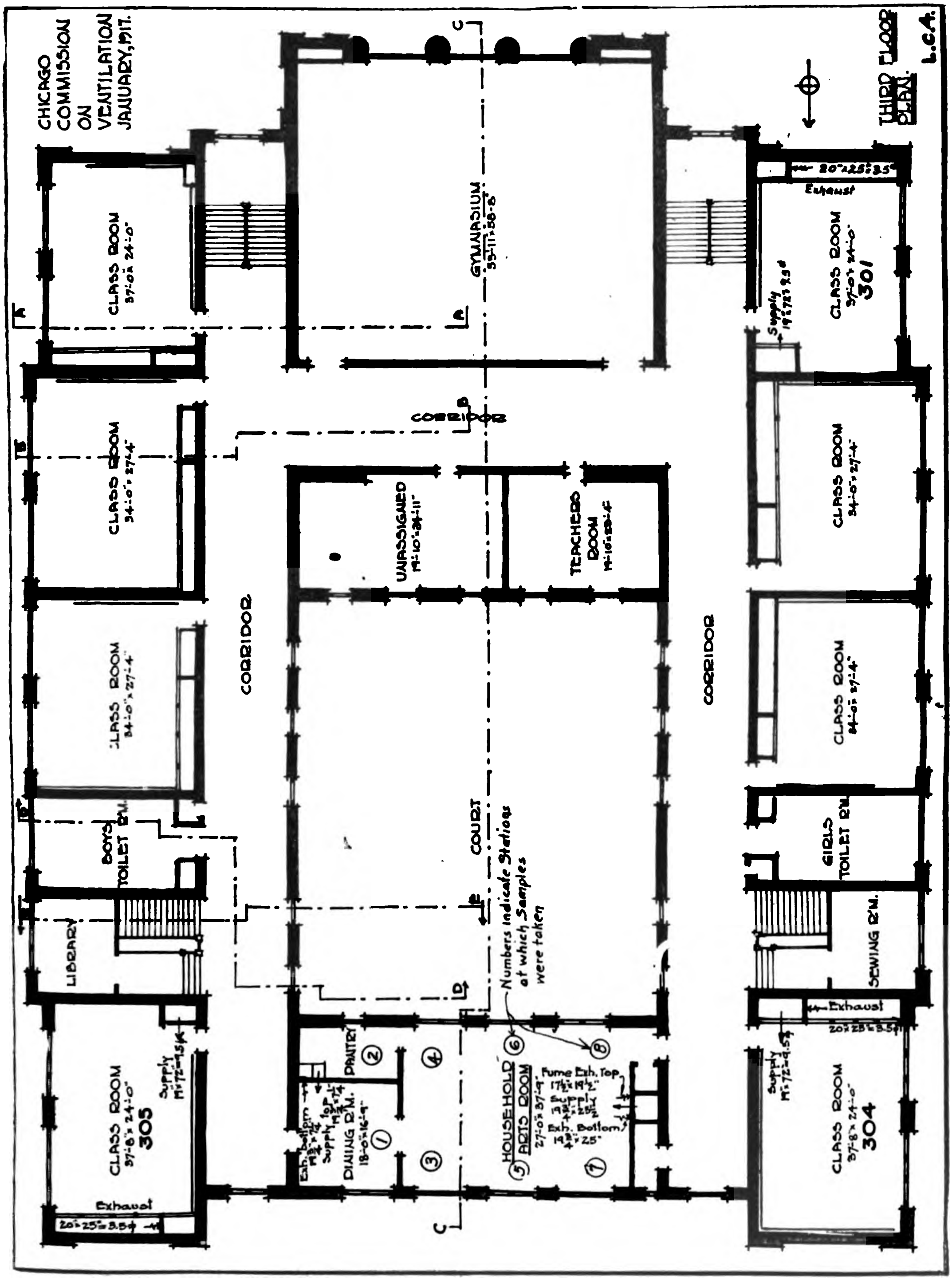
Supply velocity is result of spotting 12 points - 5 seconds each - repeated 3 times.

Exhaust velocity is average of spotting and uniform travel - 4 times.

Stations 1 = N.E. cor., 2 = S.E. cor., 3 = S.W. cor., 4 = N.W. cor., 5 = supply reg., 6 = EXHAUST REG., 7 = AT FAN INTAKE.



TEST DATA FOR ROOM 305.


CHICAGO COMMISSION ON VENTILATION JANUARY, 1917.
THIRD FLOOR PLAN.
L.C.A.
GYMNASIUM 33'-11" x 56'-8"
CLASS ROOM 37'-0" x 24'-0"
CLASS ROOM 34'-0" x 27'-4"
CLASS ROOM 34'-0" x 27'-4"
BOYS TOILET R'M.
LIBRARY
CLASS ROOM 37'-8" x 24'-0" 305
Supply 19" x 72" = 1.5 K
Exhaust 20" x 25" = 3.54
CORRIDOR
CORRIDOR
CORRIDOR
UNASSIGNED 19'-10" x 24'-11"
TEACHERS ROOM 14'-10" x 20'-6"
COURT
Numbers indicate Stations at which Samples were taken
PANTRY
DINING R'M. 18'-0" x 16'-9"
Exh. bottom 13¾" x 7¼"
Supply top 13¾" x 7¼"
HOUSEHOLD ARTS ROOM 27'-0" x 37'-9"
Fume Exh. Top 17½" x 19½"
Supply 19¾" x 25½"
Exh. Bottom 19¾" x 25"
① ② ③ ④ ⑤ ⑥ ⑦ ⑧
20" x 25" = 3.5°
Exhaust
CLASS ROOM 37'-0" x 24'-0" 301
Supply 19" x 72" = 9.5°
CLASS ROOM 34'-0" x 27'-4"
CLASS ROOM 34'-0" x 27'-4"
GIRLS TOILET R'M.
SEWING R'M.
Exhaust 20" x 25" = 3.54
Supply 19" x 72" = 9.54
CLASS ROOM 37'-8" x 24'-0" 304
A
B
C
D
E

THIRD FLOOR PLAN, LEWIS-CHAMPLIN SCHOOL.

5. The bacteria indications are fairly consistent.

Room No. 305.

March 15, 1917.

1. The amount of air delivered per occupant was 42 cu. ft. per minute. 660 cu. ft. per minute were escaping elsewhere than at the exhaust. The room in plan is a duplicate of 201, as regards supply, exhaust, and exposure, except that the exhaust is on the north end, while in 201 it is on the south end. The fan was running at 164 R.P.M., two revolutions faster than when 201 was tested. The CO_2 observations indicate rather uneven distribution, and the occupants evidently were quiet. The average CO_2 content of 7.75 parts with 42 cu. ft. of fresh air supply per occupant does not check very satisfactorily with the careful tests of room 201 and 301, in which the physical conditions are similar.

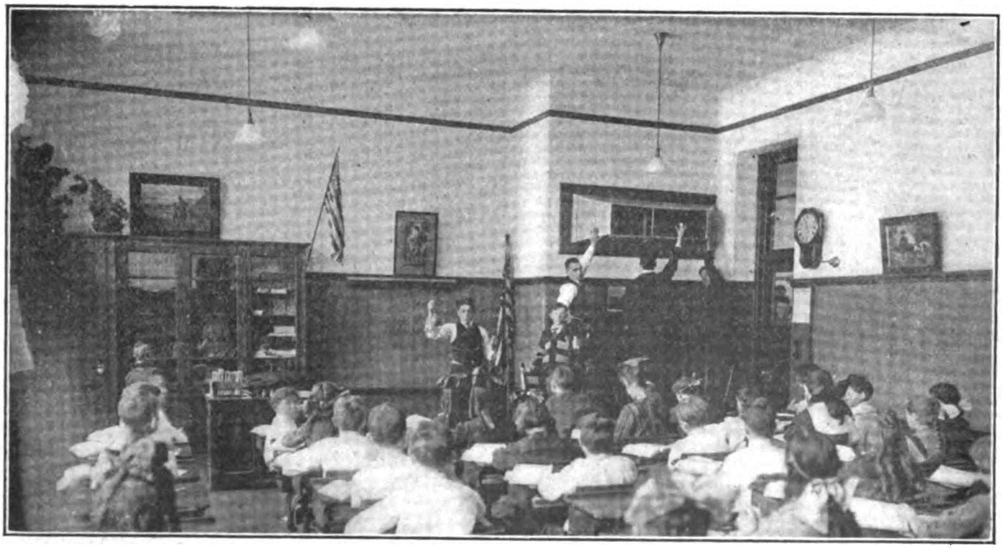
2. The room was too warm. There is perfect means in the plant to correct this fault, and this could easily have been corrected.

3. The moisture content was too low for the temperature.

3. The dust in 305 was considerably lower than in the duplicate 201, indicating, however, that the occupants of 305 were quiet.

Discussion.

Only a small number of the tests actually made are shown herewith, for the reason that these tests merely established the technique, or verified the results shown. Tests were made of the conditions in effect when recirculating, but no conclusions can fairly be drawn from them, because of the constant shifting of the population of the building from room to room, in and out of doors, etc. Since, when recirculating, the corridors are used as a return duct, open doors and transoms could not be prevented. The recirculation apparatus is used only when warming the building prior to its occupancy, and then as a matter of econ-



A TYPICAL CLASSROOM (ROOM 305) IN THE LEWIS-CHAMPLIN SCHOOL.

omy. As a safeguard, there is an indicator in the principal's office, as well as in the engine room, showing when the air is being recirculated.

1. AS TO AIR VOLUME, DISTRIBUTION, AND MOTION.

As this plant is installed, the speed of the fan is governed by the steam engine governor, and may be varied within a considerable range by the engineer, without the knowledge of the occupants of the building. Naturally, the tendency of the engineer will be to run the fan fast enough to warm the building, regardless of the requirements of ventilaton. It is suggested that a recording revolution counter for each fan, the charts of which are regularly checked by the authorities, would be desirable. A variation of ten revolutions per minute in this apparatus would make a difference of nearly 25% of the volume of air delivered. There are ribbons at the supply openings in the rooms, but these are not any evidence of an adequate delivery velocity.

An attractive feature of the combined heating and ventilating plant at the Lewis Champlin School is that it is necessary, in order to heat the rooms, to ventilate them. The heaters are so proportioned that in cold weather at least, so low is the maximum possible temperature of the hot air, that full capacity ventilation becomes necessary in order to heat the rooms. When it is considered that the fuel and labor are in direct proportion to the amount of fresh air handled in a mechanical ventilating system, the importance of this feature will be clear. A serious objection to those ventilating systems separate from the heating system, such as are used in many cities other than Chicago, is the tendency of the operating engineers at every opportunity, regardless of occupancy to close down the ventilation.

The tests indicate as satisfactory distribution of the entering air as can be expected with the dilution principle of ventilation. The corkscrew-like travel of the air around the rooms, in a gradually downward direction toward the vents, causes each station to be swept by the air, and to this extent the effect of ventilation by displacement is approached. The occupants at points in the breathing zone nearer the exhaust opening must, of course, come in contact with some of the air contaminated by others earlier in the circuit, as evidenced by an occasional high CO_2 index. Owing to local conditions, such as corners, furniture, dead centers, etc., some other high CO_2 spots were noted. These would be overcome, if the occupants of the rooms were moving about. Undoubtedly, the distribution and also the dilution would be improved, if each room were provided with a local fan to increase the currents and encourage the mixing of the entering air with that in the rooms. Such currents, if not too high velocity, will, we know, promote comfort.

So far as these tests indicate, the location of the supply opening in relation to the location of the exhaust opening has little bearing. That is, the distribution of the air in the rooms tested was fully as good where the supply and exhaust openings were on opposite sides of the room as when they followed the common practice and were both on the same side of the room.

We must conclude from the tests that the distribution of the air in these rooms is as good as is ordinarily obtained in any room having ventilation on the dilution principle. As Chicago school buildings are now built, ventilation by dilution is apparently sought, for the supply and exhaust openings are extremely large, so as to minimize opportunities for high air velocities. The volume of the air handled was not always up to the requirement and while this requirement could easily have been maintained, the plant is deficient in that no means are provided to insure a constant fan speed. The tests show the need for better distribution, and indicate to some extent the lines upon which improvement can be made.

2. AS TO TEMPERATURE.

The temperature in general was maintained at a higher point than we believe to be good practice, especially when it is possible, as it is possible here, to compensate by additional moisture content for a lower temperature. It is possible to maintain a maximum temperature of 68° F. in this building, but the tendency was to maintain 70° up to as high as 74°. We suspect, due to the unduly low humidity, that the desire of the teachers, rather than the best interest of the pupils, was consulted in setting the thermostats. With the apparatus installed, it would be as simple a matter to maintain 68° dry bulb temperature with 40% relative humidity as to carry 73° dry bulb and 25% relative humidity.

3. AS TO MOISTURE.

In general, better humidifying work can be done with an air washer, with control of the temperatures of both air and water when they are brought into contact with each other. The steam jets by our tests were doing very good work, but were not of sufficient capacity, or the controllers were adjusted too low. With the quality of Chicago water, no objectionable odor comes from the steam. With some water, due generally to the volatilazation of organic matter, the steam gives off an offensive odor and cannot be used satisfactorily for humidifying the air.

4. AS TO DUST.

The dust content is very high throughout. It seems from our tests to be no higher in the supply openings at the rooms than at the fan intake. Apparently, even if the fan handled dust free air, there would be a considerable dust content in the rooms, and this would be proportional very much more to the activities of the occupants of the rooms than to the amount of dust entering at the fan. All floors, except in the kindergarten, were oiled, and all practicable means were taken to eliminate chalk dust, but it appears from these tests that the dust in the rooms was largely foot-carried, and that it was diffused more by the activities of the occupants than by the ventilating system.

5. AS TO BACTERIA.

We believe little weight should be attached to the bacteria observations in this particular series of tests, as they seem to bear no especially marked relation to any other observed condition. We believe, however, that generally the bacteria count will be high when the dust content is high.

Conclusions

The tests at the Lewis Champlin School demonstrate the need for improvement in the design of the ordinary school room ventilating system, particularly as to the distribution of the fresh air. They indicate an opportunity for better operation, possibly for more nearly automatic control of volume, temperature, and humidity. By "automatic" we mean particularly the elimination of the human element. They show particularly the importance of further study as to means of reducing the dust content. It is not entirely clear whether the ventilating system, or other conditions, are of major importance, as affecting dust in school rooms.

The data gathered will be of the greatest value for comparative analysis with tests of other methods of ventilating in other buildings, which tests are now in progress by the Chicago Commission on Ventilation.

How to Use a Psychrometric Chart

Ten Typical Examples and Their Solution, Based on the Carrier Psychrometric Chart.

By J. I. LYLE,

President, American Society of Heating and Ventilating Engineers.

In all branches of engineering requiring more than the ordinary amount of calculation, it has long been the tendency to simplify the various computations, as far as possible, by the use of tables or charts, or both. In the field of thermodynamics no one subject has been in greater need of such simplification than air conditioning. Here we have a variety of problems in which a slight alteration of the conditions often makes an astonishing difference in the total results.

Since the development of air conditioning on its present extensive scale it has become a matter of the first importance for heating engineers to familiarize themselves with the principles involved. Up to the present time it is a matter of common knowledge that the average heating engineer has not brushed up on this subject to the extent he should in order to take advantages of his growing opportunities in this field.

Among the various noteworthy psychrometric charts that have been published is one designed by Willis H. Carrier and presented in a paper read before The American Society of Mechanical Engineers. This chart was acclaimed at the time as a classic of its kind and it immediately took rank as an authoritative exposition of the subject. Recently a new form of this chart has appeared, which is reproduced herewith.

It is generally recognized that much time and labor may be saved by the use of this and similar charts, but the fact remains that such saving depends to a very large extent on how familiar one becomes with the chart itself. In short, it is often true that while the advantages of a given chart are freely admitted, the time required to master its use often act as a deterrent to its widespread adoption.

In an effort to remove this possibility, as far as this particular chart is concerned, the following instructions have been prepared, in which almost every feature of an air conditioning problem has been presented and its solution shown on the chart.

INSTRUCTIONS FOR USE OF CHART.

All references to temperature are in degrees Fahrenheit.

Dry-bulb temperatures are represented by vertical lines, with values indicated on lower edge of chart.

Wet-bulb temperatures are represented by oblique straight lines, with values indicated on curved line marked "wet bulb temperature."

Dew-point temperatures are represented by horizontal lines and their values indicated on curved line marked "wet-bulb temperature."

Percentages of relative humidity are represented by converging curved lines, with values indicated between the oblique straight lines for 63° and 64° wet-bulb temperature.

Any two of the above properties may be found if the other two are known. First, find the point of intersection of the lines representing the given properties, and then follow through this point, the lines representing the unknown properties, and the values of the latter can be read from their respective scales.

Example 1.—Given: Dry-bulb temperature, 70°; wet-bulb temperature 60°. Find the percentage of relative humidity and the dew pont. Locate point of intersection of vertical line representing 70° dry-bulb temperature and the oblique line representing 60° wet-bulb temperature.

Reading from this point the percentage of relative humidity is 56 and the dew-point 53.4°.

Example 2. Given: Dry-bulb temperature, 80°; relative humidity, 59%. Find the dew-point and wet-bulb temperature. Locate the point of intersection of the vertical line representing 80° dry-bulb temperature and the curved line representing 59% humidity.

Reading from this point, the dew-point is 64.8° and the wet-bulb temperature 69.5°.

Example 3. Given: Dry-bulb temperature, 75°; dew-point temperature, 55°. Find percentage of relative humidity and wet-bulb temperature. Locate the point of intersection of the vertical line representing 75° dry-bulb temperature and the horizontal line representing 55° (wet-bulb scale).

Reading from this point the relative humidity is 49.8% and the wet-bulb temperature 62.3°.

Example 4. Given: relative humidity, 50%; wet-bulb temperature, 60°. Find dry-bulb temperature and dew-point. Locate the point of intersection of the curved line representing 50% humidity and the oblique line representing 60° wet-bulb temperature.

Reading from this point, the dry-bulb temperature is 71.7° and the dew point 52°.

Example 5. Given: wet-bulb temperature, 55°; dew-point, 50°. Find dry-bulb temperature and relative humidity. Locate the point of intersection of the oblique line representing 55° wet-bulb temperature and the horizontal line representing dew-point of 50°.

Reading from this point the dry-bulb temperature is 61.5° and the relative humidity 68%.

Example 6. Given: Relative humidity, 40%; dew-point, 40°. Find dry-bulb temperature and wet-bulb temperature. Locate the point of intersection of the curved line representing 40% relative humidity and the horizontal line representing 40° dew point.

Reading from this point, the dry-bulb temperature is 65.02° and the wet-bulb temperature 52°.

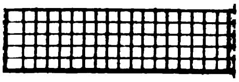
TOTAL HEAT OF AIR

The total heat of air is a function of its wet-bulb temperature, as described and proven by Willis H. Carrier in his rational psychrometric formulae. In the chart, it is taken for the sake of convenience as *above zero, degrees Fahrenheit.*

The total heat in B. T. U. is represented by horizontal lines with values indicated at the left by the scale D, "Total Heat Above Zero Degrees Contained in One Pound of Dry Air Saturated with Moisture."

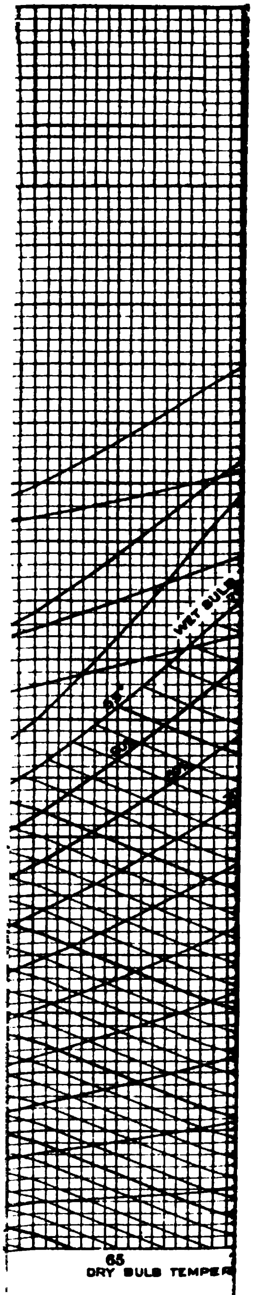
To find the total heat, the wet-bulb temperature must first be determined. Then follow the vertical line through the wet-bulb temperature reading at 100% humidity, to the "Total Heat" curve D. The horizontal line through this point of intersection represents the total heat above zero, and the value is indicated on the scale D at the left.

Example 7. Given: Dry-bulb temperature, 70°; relative humidity 60%. Find the total heat. The wet-bulb temperature determined by the method used in Example 2, is 61°. Following the vertical line through the point representing 61° wet-bulb temperature and 100% relative humidity, to its intersection with curve D and then reading horizontally to scale D on the left, the total heat above zero degrees in



HROMETRIC CH

illis H. Carrier, M.



one pound of given air is 26.7 B. T. U. The total heat to be removed in cooling air between two temperatures is found by substracting the total heat at the lower temperature from that at the upper as follows:

33.5 B.T.U., Total heat above zero degrees (dry bulb 70°)
26.7 B.T.U., Total heat above zero degrees (wet bulb 61°)
6.8 B.T.U. Heat to be removed by cooling.

ABSOLUTE HUMIDITY (GRAINS OF MOISTURE PER CUBIC FOOT)

Absolute humidity is a function of the dew-point and may be expressed either in grains per pound or dry air or in grains per cubic foot.

The grains of moisture per pound of dry air are represented by horizontal lines with values indicated on the scale A, "Grains of Moisture per Pound of Dry Air."

To find the grains of moisture per cubic foot for air under given conditions, first determine the grains per pound of dry air by finding the intersection of the (vertical) dry-bulb line and the (oblique) wet-bulb line and reading from there horizontally to scale A, "Grains of Moisture per Pound of Dry Air" at the left.

The volume in cubic feet per pound of dry air is represented by horizontal lines with values indicated by scale B, "Cubic Feet per Pound."

Find the points of intersection of the (vertical) dry-bulb temperature line with the curves B, "Volume in Cubic Feet of One Pound of Dry Air Saturated with Moisture" and "Volume in Cubic Feet of One Pound of Dry Air." Follow these horizontally to the left and read the values on scale B. The difference in these two readings of volumes is the extra volume due to moisture at 100% humidity.

To obtain the direct volume of the moisture per pound of air under the given conditions, find the volume of water vapor for the given percent. of humidity and add it to the volume of dry air.

Then grains of moisture per cubic foot or in other words the absolute humidity, is

$$\frac{\text{Grains per pound of dry air}}{\text{Cubic feet per pound of mixture}}$$

Example 8. Given: Dry-bulb temperature, 70°; wet-bulb temperature, 60°. Find the absolute humidity (grains of moisture per cubic foot).

Reading vertically on the 70° dry-bulb line and obliquely on the 60° wet-bulb line to the curve marked "Wet-Bulb Temperature", and from there horizontally to Scale A, the number of grains of moisture per pound of dry air is 61.

Then locate the points of intersection of the vertical dry-bulb line for 70° with the two curves B, and follow these horizontally to scale B at the left.

13.7 cu. ft.—Volume of one pound of dry air saturated with moisture.
13.38 cu. ft.—Volume of one pound of dry air.
0.32 cu. ft.—Extra volume due to moisture at 100% humidity.

(In instances where the air is *saturated* or *dry*, its volume may be found directly by locating the point of intersection of the [vertical] dry-bulb line with the corresponding curve B and referring to the scale B.)

The percentage of humidity for air under the given conditions is indicated where the 70° dry and 60° wet-bulb lines intersect, which by interpolating between the 60° and 50° humidity curves is 57%.

57% of 0.32 is 0.1824 cu. ft., volume of moisture in the given air.

13.38 cu. ft.—volume of dry air.
0.1824 cu. ft.—volume of moisture.
13.5624 cu. ft.—volume of one pound of the given mixture.

$$\frac{61 \text{ gr. per lb.}}{13{,}5624 \text{ gr. per cu. ft.}} = 4.499 \text{ grains of moisture per cubic foot.}$$

Vapor Pressure in Inches of Mercury depends upon the dew point and is represented by horizontal lines with values indicated by the scale E "Vapor Pressure in Inches of Mercury."

To determine the vapor pressure, read horizontally from intersection of (vertical) dry-bulb line with (oblique) wet-bulb line. Read through the wet-bulb temperature scale A and the "Vapor Pressure" curve E to the scale E at the left. The reading here is the vapor pressure. It should be noted when getting the reading for saturated air that the dew-point, wet- and dry-bulb temperatures are identical.

Example 9. Given: dry-bulb temperature 70°; wet-bulb temperature, 60°. Find the vapor pressure.

Reading vertically on the 70° dry-bulb line to the point of intersection with the (oblique) 60° wet-bulb line, and then horizontally through the wet-bulb temperature curve A, through the dew point and (wet-bulb reading is 53.5°) to the vertical scale E, "Vapor Pressure in Inches of Mercury." The vapor pressure for this point reads 0.405 inches.

TO FIND THE RESULTING RELATIVE HUMIDITY WHEN HEATING OR COOLING AIR WITHOUT CHANGING ITS DEW POINT.

Find the dew-point line for the given conditions which is the horizontal line through the point of intersection of the (vertical) dry-bulb line with the (oblique) wet-bulb line. Follow this line horizontally to the new dry-bulb temperature line and read the percentage of humidity for this point of intersection.

Example 10. Given: dry-bulb temperature, 70°; wet-bulb temperature. 60°. Find the resulting relative humidity when the air is heated to 80° (dry-bulb temperature).

The point of intersection of (vertical) 70° dry-bulb and (oblique) 60° wet-bulb lines indicates an existing humidity of 56%. Following the point of this indication horizontally to intersection with the (vertical) 80° dry-bulb line and the relative humidity reading on the curve is 40%.

A Notable Heating and Ventilating Index

A remarkable compilation of data regarding sources of information on heating and ventilating work and on mechanical equipment in general has been compiled by the American Institute of Architects and published in its Journal for October, 1917. The preparation of the index was in direct charge of D. Knickerbacker Boyd, associate editor of the Journal.

The index starts off by giving a list of the societies and associations interested in this field.

EDUCATIONAL AND RESEARCH WORK.

Under "Educational and Research Work," the following reference is given: "In THE HEATING AND VENTILATING MAGAZINE, April, 1917, it is stated that President Lyle, of the A. S. of H. and V. Engineers has appointed a committee to investigate the matter of the establishment of a bureau of research to be conducted under the auspices of the Society. When John Bartlett Pierce, one of the founders of the American Radiator Company, and its vice-president, died at his home in Lynnfield, Mass., June 23, 1917, his will was found to create a substantial surplus fund to be used for the establishment of the John B. Pierce Foundation for technical research in heating, ventilating, and sanitation 'to the end that the general hygiene and comforts of human beings and their habitations may be advanced.'"

"Boilers and Heating in General" is extensively treated, with a number of subheadings. Under "Departments of U. S. Government" are given the titles of a number of Government publications, special attention being called to the fact that "the U. S. Weather Bureau compiles for THE HEATING AND VENTILATING MAGAZINE complete records of the weather in five different localities, which are published, with charts and complete data."

The second sub-heading, "Boiler Standards" refers to the boiler code of the A. S. M. E. and gives the titles of a number of books and articles dealing with this subject. It also speaks of the American Uniform Boiler-Law Society which exists for the purpose of promulgating the A. S. M. E. Code as the legal boiler construction code for all the States. It is stated that the code is now operative in nine States and eight municipalities.

RATING HOUSE HEATING BOILERS.

Under the third sub-heading, "Rating and Testing of House Heating Boilers," the work of the National Association of Master Steam and Hot Water Fitters is mentioned, as well as that of the heating engineers' society. Note is made of the fact that the heating engineers' society has a committee on "Code for Testing Low-Pressure Heating Boilers." This committee expects to make a final report at the coming January meeting of the society. Prominence is given in the index to a letter received from a prominent manufacturer of boilers connected with an important association who states:

"If the American Institute of Architects could bring about the establishment of a standard method of rating heating boilers it would mean a great step forward in boiler manufacturing.

"Practically every boiler manufactured today, no matter what its catalog rating, will actually develop its catalog rating, but the manufacturer does not tell how it has to be handled to develop its rating. Some boilers, to deliver their rating, have to be fired every four hours with a draft so intense that it almost equals a forced draft, so great is the rate of combustion per square foot of grate. Such a condition, of course, is not reasonable for a heating plant, and the only way to eliminate it is to surround the definition of how a boiler should be rated with certain safeguards.

AMOUNT OF HEATING SURFACE REQUIRED ON HOUSE-HEATING BOILERS.

"For maximum economy with any kind of fuel, a boiler should be proportioned so that at least one square foot of heating surface should be given for every 3.45 lbs. of water to be evaporated from, and at 212° F. per hour.

"For each 100 sq. ft. of standard direct cast-iron radiation in still air, or its equivalent, 7.25 sq. ft. of heating surface should be used, or that each square foot of heating surface in heater take care of 13.8 sq. ft. of standard direct cast-iron radiation or its equivalent, which is 3.45 lbs. of water per hour from and at 212° F.

"The above figures are based on the calculation that for each square foot of direct radiation, ¼ lb. of water is condensed per hour from and at 212° F. The heating surface is as recommended by the American Society of Mechanical Engineers.

"Due to the wide difference in coal, it is impossible to specify the exact ratio of grate to heating surfaces, but the following will cover the situation.

"That a grate area or its equivalent be furnished so that a firing period of not less than eight hours may be obtained."

HEATING IN GENERAL.

Under "Heating in General," the fourth sub-head, attention is called to the various works on the subject. The reader is also referred to the "Review of Current Technical Literature" in the Journal of the A. S. M. E. Other references are given as follows:

The A. S. of H. and V. E. is conducting investigations to determine the relative efficiency of a heating plant during the different periods of the heating season, dividing it up into periods of twenty days for each period and considering a heating season as 160 days, more or less, the first ten days and the last ten days being considered as one period and so on; this will determine the efficiency of the plant at slow, medium and maximum combustion, and thus determine the relative efficiency of each rate of combustion from a number of such tests.

The following reprints of papers issued by the A. S. of H. and V. Engineers are given:

1. "Design of Indirect Heating Systems —Maximum Economy and Operation," F. L. Busey and W. H. Carrier, 1913. 10 cents.
2. "Heating and Ventilating of Federal Buildings," N. S. Thompson, 1910, 10 cents.
3. "Development in Heating and Ventilating Industrial Buildings," E. L. Hogan, 1915, 10 cents.
4. "Office Practice in Estimating Heating and Ventilating," J. D. Small, 1912, 10 cents.

5. "Heating a Swimming Pool," C. Teran, 1912, 10 cents.
6. "Report of Committee on Steam Heating Residences," 1910, 10 cents.
7. "Hot Water heating system of Crane Company's Chicago Works," F. E. McCreary, 1917, 10 cents.

The following articles are also cited which appeared in THE HEATING AND VENTILATING MAGAZINE:

1. "Notes on the Rise of the Smokeless Boiler," October, 1916.
2. "Relative Economy of Heating by Steam at Different Pressures," A. Bement, February, 1917.
3. "The Care of a Vacuum Heating System in the Summer Months," August, 1917.
4. "A Survey of Operating Costs in Thirteen School Buildings, Jamestown, N. Y.," J. M. Cushman, November, 1916.
5. "The Comparative Effects of wind and sunshine on Buildings," D. B. Prentice, June, 1916.
6. "Fuel Economies in House Heating," H. R. Johnson, December, 1916.
7. "Failure to Heat Premises—Tenant's Remedy," February, 1916.
8. "An Extensive Open-Tank Gravity Hot Water Heating System," George Stumpf, Jr., October, 1914.
9. "Hot Water Heating on a Large Scale, New York State School of Agriculture," November, 1915.

Other references are as follows:

"Lefax" issues, among others, the following data sheets:

1. "Heating," from "Mechanical Equipment of Federal Buildings," N. S. Thompson, Chief Mechanical and Electrical Engineer, Supervising Architect's Office. (3-52.)
2. "Design of Steam and Hot Water Heating Systems," M. William Ehrlich. (4-96.)

See "Mechanical Equipment of Buildings," a reference book for engineers and architects, by Louis A. Harding and Arthur C. Willard.

1. Volume I: "Heating and Ventilation." A reference book for architects and engineers, 1916. 619 pp. The authors have found it necessary, in their own experience to make extensive use of manufacturers' data in designing the various mechanical systems or plants required in modern buildings. They have therefore not hesitated to include such data in the text, in order to illustrate and facilitate the design of similar systems in each subject treated.
2. Volume II: "Power Plants and Refrigeration."

"School Architecture," W. G. Bruce. Fourth edition. For architects and school authorities. Chapter on Heating and Ventilating treats most of the subjects in this issue.

"Handbook for Heating and Ventilating Engineers," James D. Hoffman. With tables and charts, on design and installation, widely used in colleges.

"The Heating and Ventilating of Buildings." Rolla C. Carpenter.

"Manual of Heating and Ventilation," F. Schumann.

The Mechanical Equipment of Federal Buildings under Control of The Treasury Department, N. S. Thompson, has chapters on:

> I. Heating and Ventilation. II. Commercial Practice in Regard to Heating Factory and other Buildings. III. Commercial Practice in Regard to Heating by forced Circulation of Hot Water from a Central Station.
>
> This book, written by the Chief Mechanical and Electrical Engineer, office of Supervising Architect, is especially interesting as an exemplification of the practice in that office and contains, besides data elsewhere referred to, discussions on general practice, schedules of piping sizes, sample specifications of the office, estimating data for apparatus in new federal buildings, ducts, flues, tables, and other information applicable to all features of heating and ventilating in all kinds of buildings.

"Heating and Ventilating Plants," Charles L. Hubbard. Covers heating and ventilation as applied to all classes of buildings, from the small, furnace-heated dwellings to structure of the largest size. 300 pp., illus.

"Heating and Ventilation," C. L. Hubbard. A practical manual of hot-air, steam and hot-water heating, and of modern systems of ventilation. 256 pp., illus.

See "Heat Engineering," Arthur M. Greene, Jr.

"Notes on Heating and Ventilation," Prof. John R. Allen. A résumé of lectures delivered to classes in heating and ventilation at the University of Michigan. 272 pp.

"Mechanical Equipment of School Buildings," Harold L. Alt. 112 pp., illus. Contains Chapters as follows (other Chapters referred to elsewhere):

> I. Heating and Ventilating. II. Ducts and Flues. III. Heating and Ventilating Special Rooms. IV. Ventilating Toilets and Laboratories. XIV. The School Power Plant. XVIII. Vacuum Cleaning.

"The Ventilation, Heating and Management of Churches and Public Buildings," J. W. Thomas. 148 pp., illus.

"Modern Theatre Construction," Edward Bernard Kinsila. Contains information on Heating and Ventilation.

"Heating by Hot Water, Ventilation and Hot-Water Supply," Walter Jones. 360 pp., illus.

"Hot-Water Heating and Fitting," William J. Baldwin. 306 pp., illus.

"Warming Buildings by Hot Water," Frederick Dye. 319 pp., illus.

"Practical Steam and Hot-Water Heating and Ventilation," Alfred G. King. Contains rules, tables, and 300 illustrations, showing in detail all the various heating systems, with pipe, radiator and boiler connections.

"Steam Heating for Buildings," Wm. J. Baldwin, M. Am. Soc. C. E. Descriptive of steam heating apparatus for warming and ventilating large buildings and private houses. 404 pp., illus.

"Heating by Steam and Hot Water," Charles B. Thompson. Has short rules for computing radiation, heat-losses, charts, illustrations, and descriptions of how best to heat water for baths, swimming-pools, etc. 265 pp., illus.

The Engineering Experiment Station of the University of Illinois issues:

1. "The Economical Purchase and Use of Bituminous Coal for Heating Homes." A new bulletin. 2. A circular on the installation of a house-heating system, showing the most economical methods of firing soft coal and operating a house-heating plant.

See "*Building Code*" recommended by the N.B. of F.U., 1915. Part XXVI, pp. 173-184, entitled "Chimneys, Flues and Heating Apparatus," contains Sections 178-185 on Chimneys, Smoke-Flues, Gas-Flues and Fireplaces; Smoke-Pipes; Heating Furnaces and Appliances; Stoves and Ranges; Hot-Air Pipes and Registers; Steam and Hot-Water Pipes; Vent-Flues and Ducts; and Dry Rooms. Includes diagrams.

See "Field Practice," Inspection Manual of the N.F.P.A., 1914. Contains sections as follows:

1. Sec. II: "Heating Hazards." Treats of Radiation and Conduction of Heat; Effect of Continuous Heat upon Heating Devices; Furnaces and Heating Devices of a Fixed or Stationary Type —Grading of Furnaces—Setting and Mounting — Clearance — General Features of Installation; Furnace Stacks, Chimneys and Flues, Breeching-Features of Installation; Hand or Movable Furnaces; Special Treatment of Miscellaneous Heating Devices; Common Miscellaneous Hazards, in connection with Use of Heat (including: Blower Systems for Heating, Ventilating, Stock and Refuse Conveying).
2. Sec. III: "Power Hazards, including Refrigeration." Treats of Steam Boilers; Electric Power—Electric Motors; Gas and Gasoline Engines; Fuel-Oil under Boilers and Furnaces, and for Domestic Use; Refrigeration.
3. Sec. VII: "Chimneys and Flues." Treats of proper construction of chimneys and flues and gives Instructions for Repairing Old Chimneys.

"A Handbook for Superintendents of Construction, Architects, Builders, and Building Inspectors," H. G. Richey. 357 pp. Superintendent of Construction, U. S. Public Buildings.

"Building Foreman's Pocket Book and Ready Reference," H. G. Richey. 1,118 pp., 656 figures.

See "The Building Estimator's Reference Book," Frank B. Walker, 1917. Contains a chapter on "Steam and Hot-Water Heating," pp. 3,200-3,207, which gives data for estimating steam and hot-water heating, sizes and costs of boilers, pipe and fittings, radiation and bronzing.

"Principles of Heating," by William G. Snow.

BLOWERS AND FANS.

A section is devoted to "Warm Air Heating, Stoves, Ranges and Dryers," and this is followed by a section on "Blowers, Fans and Ventilation in General." This section has the following references:

(See the references under Heating in General, the majority of which contain sections covering the subjects included in this heading.)

1. The A.S.H. and V.E. is cooperating with biologists, physiologists, sanitarians, and psychologists to determine, if possible, whether the air in buildings is necessarily less healthful than the outer air, and if so, why. This work is covering a wide range of research and a thorough investigation into every phase of the subject.

   It is investigating the question of improvements in washing and conditioning the air to further improve the art of ventilation and is conducting experiments to standardize the various operations necessary to furnish adequate ventilation.

   Its committees are at work formulating requirements for ventilating buildings to guide the various state legislatures in making up codes for the regulation of such requirements in public and semi-public buildings.
2. See "Report of Committee on Minimum Ventilation Requirements for Public and Semi-Public Buildings for

"Legislation Purposes" of the A.S.H. and V.E. Contains General Suggestions on Compulsory Ventilation, applicable to all classes of buildings, and Special Minimum Heating and Ventilating Requirements applying to all Schools, Colleges, Factories, Workrooms, Theatres, and Motion-Picture Houses. 23 pp.

3. Reprints of papers by the A.S.H. and V. E.:

"Report of Committee on Blower systems," A. M. Feldman. 1914. 10 cents.

"Report of Committee on Fan Blast Heating (1)." 1909. 10 cents.

"Report of Committee on School-room Ventilation." 1913. 10 cents.

"New York State Commission on Ventilation—1915," Geo. T. Palmer. 1916. 20 cents.

"Open Windows with Mechanical Ventilation," R. C. Taggart. 1912. 10 cents.

"Ventilation of Telephone Booths," R. L. Douglass. 1914. 10 cents.

"The Centrifugal Fan," F. L. Busey. 1915. 20 cents.

"Report of Committee on Method of Taking Anemometer Readings." 1913. 10 cents.

4. See "Suggested Regulations of the N.B.F.U. for Blower Systems for Heating and Ventilating; Stock and Refuse Conveying as Recommended by the N.F.P.A." These have also been published in the *Heating and Ventilating Magazine* as Standard Heating and Ventilating Data Sheets, August, 1917.

5. "Ventilation Laws in the United States," published by the Heating and Ventilaing Magazine Company. Contains Board of Health Requirements and Regulations of N.B.F.U., together with Model Ventilation Requirements as Promulgated by the A.S. of H. & V.E. 178 pp.

5. "Some Modern Methods of Ventilation," R. Grierson. 187 pp. With special reference to public buildings. Contains information for health authorities, architects, heating, sanitary and electrical engineers, sheet-metal workers, and others who may be called upon to install ventilating apparatus.

7. See "The Design of Blower Heating Systems for Factory and Shop Buildings," L. A. Harding and J. A. Moyer. Published by the Pennsylvania State College Engineering Experiment Station in Pennsylvania State College Bulletin, June, 1913. 60 pp.

8. The Ventilation Hand Book, C. L. Hubbard. 218 pp. and diagrams relating to Ventilation as applied to Furnace Heating Ducts, Flues and Dampers for Gravity Heating; Fans and Fan-work.

9. "The Ventilation of the School-room," Wm. J. Baldwin, M.E. 46 pp., illus.

10. "The Ventilation, Heating and Lighting of Dwellings," J. W. Thomas. Illus.

11. "The Fan," Charles H. Innes. 1916. 302 pp., illus. Includes the Theory and Practice of Centrifugal and Axial Fans, revised by W. M. Wallace and F. R. Jolley.

12. See "Motion-Picture Houses in New York City Inadequately Ventilated," *The Heating and Ventilating Magazine*, May, 1916.

13. For notes on "Air Cooling of Houses," from an address by Alexander Graham Bell in *National Geographic Magazine*, see The Builders' Guide of Philadelphia, October 10, 1917.

DUCT CHARTS.

(*a*) "Tables for Ventilating Ducts," Chouteau E. Pearce, M.E., published on stiff cards by the Heating and Ventilating Magazine Company. These tables are useful in rapidly estimating superficial area and weights of galvanized sheet-iron rectangular ducts, as usually employed in ventilating work. 50 cents.

(*b*) "Chart for Figuring Round and Rectangular Ventilating Ducts," Chas. A. Fuller. *The Heating and Ventilating Magazine*, August, 1916.

(*c*) See Pehl's Everready Pipe and Elbow Chart. 54 pp.

AIR CONDITIONING AND TEMPERATURE CONTROL.

The section on "Air Conditioning, Temperature Control," has the following references: Publications listed under Heating in General will be found to treat of these subjects.

1. These are also embraced within the activities of the A.S. of H. & V.E. in connection with Ventilation investigations, and in the Report of the Committee on Minimum Ventilation Requirements it is stated:

   "Temperature control, preferably of an automatic type, shall be required for all heated and ventilated rooms. The temperature regulator, whether by automatic or hand control, shall be so arranged that its operation will not decrease the required volume of air-supply for ventilation."

2. The A.S. of H. & V.E. is investigating to determine the best method of dust prevention and humidifying the air from furnaces, and to regulate or control the same. Also to test and determine the

value of temperature-controlling devices for hot-air apparatus.

3. The following reprints of papers by the A.S. of H. & V.E. are of interest:
    - (*a*) "Report of Committee on Air Washers," 1910. 10 cents.
    - (*b*) "Preliminary Report of Committee on Standardizing the Testing of Air Washers," A. E. Stacey, Jr. 1914. 10 cents.
    - (*c*) "Humidity in Relation to Heating and Ventilation," L. C. Soule. 1912. 10 cents.
    - (*d*) "Improved Air Conditions in a Boston Residence," F. I. Cooper. 1913. 10 cents.
    - (*e*) "Studies in Air Cleanliness," G. C. Whipple and M. C. Whipple. 1915. 10 cents.
    - (*f*) "Problem of City Dust," R. P. Bolton. 1915. 10 cents.
    - (*g*) "Temperature Equivalents of Wind Velocities," H. W. Whitten. 1912. 10 cents.
4. See *Heating and Ventilating Magazine:*
    - (*a*) "New Ideas in Air Conditioning," W. E. Watt. February, 1916.
    - (*b*) "Air Conditioning for Factory Offices." May, 1917.
    - (*c*) "Tests of Air Conditions in an Illinois School," E. V. Hill, M.D. May, 1916.
    - (*d*) "Heating and Ventilation of School Buildings." Washed recirculated air compares favorably with fresh air. September, 1916. (See, also, correspondence, October, 1916.)
    - (*e*) "A Simple Method of Figuring the Economy of Humidity." May, 1917.
    - (*f*) "Fuel Economy with Increased Humidity." March, 1917
    - (*g*) "Humidity and Automatic Control," Harold L. Alt. July, 1916.
    - (*h*) "Re-establishment of Temperature Control on a central Station Hot Water Plant." April, 1917.
5. The literature of manufacturers of these specialities will usually be found to go fully into details.

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CHIMNEYS, FLUES AND FIREPLACES.

Some notes are given on "Natural Ventilation," the next section being "Chimneys, Flues and Fireplaces," which reads as follows:

In the design of these, efficient proportions and construction tightness should be the first consideration, as a protection against fire and to afford a proper draft. The successful operation of any installation may be greatly impaired, if not entirely defeated, by inadequate size or lack of tightness in the joints of the flue.

The N.F.P.A. and the N.B.F.U. have issued valuable illustrated literature on the subject. Drawings and descriptions are to be found therein and in many of the handbooks and other publications.

Valuable data for calculating the area, height, design, erection and successful use of chimneys and flues will be found in many of the publications listed under "Heating in General" and "Hot-Air Heating," and in some of the hand-books and literature of manufacturers who are alive to the necessity of providing adequate draft as a precedent to satisfactory operation of any plant.

The A.S. of H. and V. Engineers proposes experiments to determine a standard for the size and height of chimneys and the strength of draft needed for a given operation; the value of round and square chimneys; the relative efficiency of smooth tile-lined compared with the ordinary brick flues; the effect on the draft of diving and underground flues; the friction and heat loss necessary to overcome the extra travel; the explanation in a practical manner of the laws governing drafts in chimneys and for formulating a standard method of building chimneys to prevent defective drafts.

Read "Chimneys: Their Design and Construction," by Harold L. Alt, in THE HEATING AND VENTILATING MAGAZINE for March and April, 1917. Mentions common errors in chimney work, describes the use of draft gauge and methods to obviate chimney leakage, gives recommendations for construction, making connections and a table for calculating sizes of flues for residences in proportion to cubical contents of building. Contains illustrations and table of commercial sizes and areas of flue tile. Gives designing data for chimneys and power plant stacks, friction loss charts for brick and steel stacks, and a theoretical draft chart for stacks.

"Chimney Design and Theory," by W. W. Christie. A book for engineers and architects. 200 pp., illus. Contains formulas, tables, wind-pressure, flues, lightning protection, general information.

"Chimney Design," edited from various sources, by Walter Loring Webb, C.E. "Lefax" data sheet No. 4-106.

See THE HEATING AND VENTILATING MAGAZINE:

"Things to Remember About Chimneys," by E. C. Molby, October, 1916.

The "Ideal Fitter," of the American Radiator Company gives, in connection with each boiler described and illustrated, the size and height of chimney flue required. It also contains "Notes on Chimney Flues," with a table of commercial sizes of tile and unlined brick flues.

PIPES, VALVES AND FITTINGS.

"Pipes, Valves and Fittings" are the subject of the following references:

1. The A.S.T.M. has adopted "Standard Specifications for Welded Steel and Wrought Iron Pipe."

4. A.S.M.E. Standards recommended in reports of committees received by the Council of the Society and separately published on:
    - (*a*) Standard pipe, pipe-threads and pipe-unions.
    - (*b*) Identification of power-house piping.
    - (*c*) Standard threads for hose-couplings.
    - (*d*) Standardization of pipe-thread gages.
    - (*e*) The American Standard for pipe flanges, fittings and bolting.

5. The National Association of Master Steam and Hot Water Fitters issues:
    - (*a*) The 1915 U. S. Standard Schedule of Flanged Fittings and Flanges, on which is stated: "The dimensions of the 'American Standard' are identical with the above, and this Schedule was adopted March 20, 1914, by a joint committee of this Association, the A.S.M.E., and the Committee of Manufacturers on Standardization of Fittings and "Valves." Cardboard. 24x35 inches. $1.
    - (*b*) The same as a Chart 9x12 inches.
    - (*c*) A folder giving separate schedule of the "Standard" flanges and "extra heavy" flanges.

6. The N.F.P.A. prints in "Proceedings":
    - (*a*) Reports of Committee on Standardization of Pipe and Pipe Fittings.

7. The A.S. of H. & V.E. has issued Reports of Committee on Corrosion in pipe, and is now collecting data relating to sizes of pipes used in steam- or water-heating plants; will tabulate such data that the sizes needed for any part of a plant will be readily understood, and continue experiments to add what data may be needed to complete the subject.

8. "Dimensions and Weights of Pipe and Fittings," compiled by the Editors of *Power.* Covers all standard pipes and their fittings.

9. See "Lefax" Data Sheets, as follows:
    - (*a*) "Economical Design of Steam Piping," A. Langstaff Johnson, Jr.
    - (*b*) "Resistance of Pipes to Internal and External Pressure," K. F. Adamson.

10. "The Friction of Water in Iron Pipes and Elbows," paper by F. E. Giesecke, of the University of Texas, read before A.S. of H. & V.E., July, 1917.

11. See HEATING AND VENTILATING MAGAZINE:
    - (*a*) "Pipe Symbol Chart," T. W. Reynolds. February, 1916.
    - (*b*) "A Handy Chart for Determining the Weight of Pipe," W. F. Schaphorst. March, 1917.
    - (*c*) "Pipe Hangers," Harold L. Alt. March and April, 1916.
    - (*d*) "A British Tribute to the Superiority of American Pipe." October, 1916.
    - (*e*) "Importance of Supervising Piping in Customers' Buildings," D. E. Karn, of Consumers' Power Company, Grand Rapids, Mich. August, 1917.

12. "A Handbook on Piping," Carl L. Svensen. 350 pp., illus. Has convenient information and data on piping, fittings, pipe joints, valves, piping drawings, pipe lines, and their accessories.

13. "Pipes and Piping," Hubert E. Colling. Included in the contents are: Steam-pipe conduits; pipe fittings; sizes of pipe; how to distinguish steel from iron pipe; a color scheme for pipe lines; effect of superheated steam on cast-iron valves and fittings.

14. "The Design of Valves for Use in High Class Buildings," M. W. Link. Paper No. 172 in the *Journal of the Society of Constructors of Federal Buildings,* March, 1915, pp. 133-142.

15. Pipe Fitting Charts, Wm. G. Snow. 284 pp., 220 figures of piping and apparatus for hot-water, steam, and other types, including ducts.

RADIATORS, REGISTERS AND GRILLES.

Under "Radiators, Registers and Grilles," is given the following:

The A. S. H. and V. Engineers has special committees to determine the most effective place for a radiator in a room and to recommend a standard method of testing radiators. Investigations are being conducted to determine: (*a*) the relative value or ratio of one-, two-, three- and four-column radiators; (*b*) the relative value or ratio of different heights of radiators from 18 to 45 in.; (*c*) the effect of painting, bronzing or enameling radiators; (*d*) the loss in efficiency when the radiator is enclosed in a recess with only the front exposed, with the front covered with a grill, with the radiators all enclosed with only an opening at the bottom for air and a register at top in proportion to the surface in the radiator; (*e*) the ratio of efficiency of a window radiator enclosed under a seat; (*f*) the ratio of fresh-air inlet and warm-air outlet per square foot of indirect surface; (*g*) the ratio of register to indirect surface, to determine the frictional resistance of the ornamental face of a register.

The following reprints of papers by the A. S. H. and V. Engineers are of interest:

1. "Wall Radiators vs. Long Pipe Coils," J. A. Donnelly, 1906. 10 cents.
2. "Effect of Painting Radiator Surfaces," J. R. Allen, 1909. 10 cents.
3. "Determining the Volume of Air Passing Through Register," J. H. Kinealy, 1897. 10 cents.
4. "Comparison of Pipe Coils and Cast-Iron Sections for Warming Air," J. R. Allen. 10 cents. Contains tests demonstrating that condensation for both types of surface depends upon friction of air through the heater.

See THE HEATING AND VENTILATING MAGAZINE:

1. "Determination of Radiator Sizes for Hot Water Heating Plants," Freywid Wegelius. January and April, 1916.
2. "Best Position for a Radiator in a Room." September, 1916.
3. "Requirements for Radiator Humidifiers." E. P. Lyon. August, 1917. Contains description of new type capable of evaporating 2.9 gal. per square foot of hot water radiator per day.
4. "Apparatus for Testing Heat Transmission from Radiators." May, 1916.

METAL WORK AND DUCTS.

Under "Metal Work, Ducts, Chase Lathing," are listed the following articles from THE HEATING AND VENTILATING MAGAZINE:

"Standard Practice for Sheet Metal Work in Ventilating Systems," T. W. Reynolds. December, 1916.

Comparison of various Methods of Figuring Duct and Flue Sizes," Harold L. Alt. October, 1916.

HEAT TRANSMISSION, INSULATION AND COVERINGS.

The remaining sections are devoted to "Air Leakage, Guarantees and Formulas," "Heat Transmission, Insulation, Coverings," and "Mechanical Equipment in General—Power Houses and Cold Storage Plants." The section on "Heat Transmission" is as follows:

1. The A.S. of H. & V.E. is collecting and tabulating data of all tests relating to heat-losses through building materials. It will collate the results of new tests till the heat-losses of all materials used in a modern building have been ascertained, and then maintain authoritative data for use as a basis in determining the heating surfaces necessary for buildings of various types.

   It will collect data relative to the heat-loss through covering materials and make tests to verify them and determine the value of insulating materials used for insulating buildings, boilers, pipes, cooling pipes, cooling machinery, and other apparatus.
2. In an address before the N.A.M.S. and H.W.F. in June, 1916, by D. Knickerbacker Boyd, the editor of the Journal's "Structural Service Department," he said, "In the matter of sectional covering and banding on lateral runs, plastic covering on flanges, couplings and fittings, and on the heating apparatus itself, surely some standards of practice could be developed which would greatly aid in establishing a uniform basis of estimating."
3. See "Specification for 85 per cent Magnesia Non-Conducting Coverings for Power and Heating Systems" (received March 8, 1917, but not dated), described in a letter, from Prof. Thomas Nolan, Chairman Committee on Materials and Methods, A.I.A.
4. The Low Pressure Covering Manufacturers' Association has under consideration the recommendations of its Standard Committee for a specification on Air Cell and Wool Felt Covering. It is expected that specifications for the uniform proper application of such coverings will be given consideration later on.
5. See "List of Inspected Mechanical Appliances," published by Underwriters' Laboratories, for Heat Insulating Coverings and Pipe Coverings.
6. See "Mineral Resources of the U. S.," issued by U. S. Geological Survey, 1915, Part II, "Nonmetals," for Chapter on "Asbestos."
7. See "Practical Laws and Data on the Condensation of Steam in Covered and Bare Pipes," C. P. Paulding. To this is added a translation of Péclet's "Theory and Experiments on the Transmission of Heat Through Insulating Materials." 107 pp. Illus.
8. See "Transmission of Heat Through Cold-Storage Insulation," C. P. Paulding. Formulas, Principles, and data relating to insulation of every kind. 41 pp., illus.
9. See Reprints of Papers by the A.S. of H. &V.E.:
   - (*a*) "Heat Transmission with Pipe Coils and Cast Iron Heaters," L. C. Soule. 1913. 10 cents.
   - (*b*) "Heat Losses through Building Materials," L. A. Harding. 1913. 10 cents.
   - (*c*) "Heat Losses and Heat Transmis-

sion," Walter Jones. 1906. 10 cents.
  (*d*) "Heat Transmission through Building Materials," John R. Allen. August, 1916.

10. See THE HEATING AND VENTILATING MAGAZINE:
  (*a*) "Government Experiments on Heat Transmission through Walls." September, 1916.
  (*b*) "Effect of Velocity and Humidity of Air on Heat Transmission through Building Materials," J. A. Moyer. February, 1916.
  (*c*) "The Heat Insulating Properties of Commercial Steam Pipe Coverings," L. B. McMillan. January, 1916.
11. The Bureau of Standards, in addition to several commercial tests, has been making investigations upon about twenty-five different kinds of materials, the samples being purchased in the open market. These include flax, asbestos, and cork products, and a wide variety of special materials. An investigation of the thermal conductivity of wood is in progress, several varieties having been meaured. The very great importance of confined air-spaces in the construction of insulating walls led to an extended investigation of the laws governing heat transmission by confined air, which is being continued.

◆

Recent Development of the Baldwin Air Cooling, Drying and Purifying Apparatus.

About two years ago William J. Baldwin, of New York, designed an apparatus that could be placed in the porthole or the deadlight of a ship and which would exclude the rain or spray, while freely admitting large quantities of air to the cabin of the ship, without admitting the water. This led to freeing the air of an excess of humidity.

A description of Mr. Baldwin's machine was given at the last annual meeting of the heating engineers' society and published in THE HEATING AND VENTILATING MAGAZINE for February, 1917.

A further description is given in a paper presented by Mr. Baldwin at the recent meeting of The American Society of Mechanical Engineers in which he states:

The experiments conducted with the preliminary apparatus for excluding rain or spray while freely admitting the air as in the case of a ship rolling heavily at sea, suggested the possibility of removing the excess of humidity in the air, particularly with a view to admitting air to the radio room of a ship, and not only exclude the rain and spray but also regulate the humidity, so as to keep the air at ***some common standard of saturation*** as far as humidity was concerned. The purpose was to overcome a difficulty with the attuning apparatus of the receiving and sending instruments, either at sea or in the higher atmosphere.

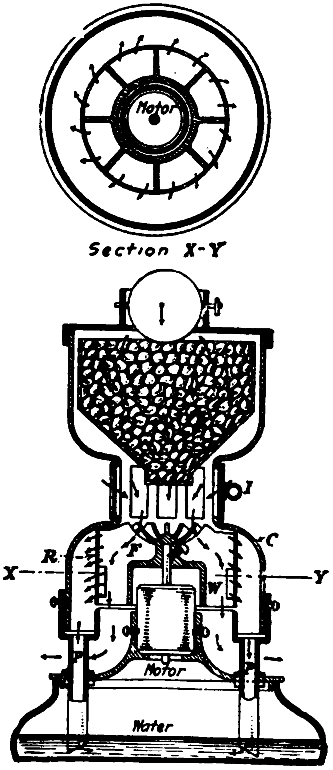

FIG. 1—BALDWIN AIR DRYER AND COOLER, SHOWING PRINCIPLE OF CONSTRUCTION.

This led to the design of an apparatus for a radio room on the lines already set forth, that would admit air not only separated from rain, salt spray and spume, but that would also condition or regulate the humidity within the room by keeping it at a common standard of humidity, regardless of the outside changes.

Cold water in the spray form will do this, provided the spray can be gotten rid of after it has combined with the excess of humidty (steam in the air) and then separated from the air by some practicable form of apparatus that is simple and clean, and that occupies small space.

While "a shower of rain will clear the atmosphere," the elements of nature have all outdoors in which to set up the apparatus for such a result. The cabin of a ship or a radio cabinet is infinitely small in comparison with all outdoors, yet a similar result can be achieved in a space as small as a cabin or radio cabinet.

To accomplish this I used a cold-water spray apparatus similar to one I had designed two years earlier for the purpose of precipitating the CO_2 when found in great excess in a confined space, as in the hold of a submarine, when forced to stay a long time under water.

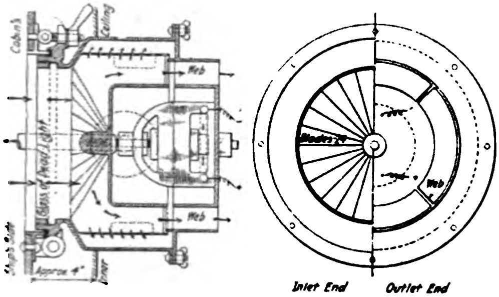

FIG. 2—APPARATUS ATTACHED TO PORTHOLE OF SHIP.

In this machine a spray of potash water was used in connection with a mechanical dust precipitator for the purpose of seizing on the carbonic acid in the air and throwing it down, so as to eliminate the CO_2 at the dust and water discharge of the apparatus.

It was proposed to put the apparatus in a bulkhead; the discharge side of the apparatus coming into the air of the living quarters, the air freed of its CO_2 being forced back again into the chamber of greatest vitiation, thus forming a cycle.

In the general experiments it was found that a prepared spray of chemical liquid or even cold water not only seized on the dust but on the other gases in the air, with which the chemical in the spray would combine, and that a pure-water spray turned into the apparatus would keep the humidity of the air constant by suitable regulation of the temperature of the water spray. In a room of 90° F. and a humidity of almost 90%, we could drop the humidity to 45% by reducing the temperature of the spray to 70° F.

A simple form of the apparatus arranged for cooling a room is shown in Figs. 1 and 2. The apparatus from the inlet to the line X-Y (Fig. 1) is an ordinary fan or blower F, and the downward extensions of the fan blades or wings W are necessary to accelerate the rotary motion of the air.

The rotor R is a rotating hoop of mermeable metal, against the inner side of which the air is thrown with all its impurities. If the heavy particles in the air, such as dust, mud or particles of water, strike into the perforations of the hoop, they pass through into a quiet space formed by the outer case C. Or, if they strike on the solid part of the hoop, they are rubbed through the nearest holes by the forward movement of the air. They then pass into the quiet space C, drop down within it, and escape by the pipe or pipes P into the tank.

The air does not escape with the heavy particles, as might appear at first, for the lower ends of the pipe legs are sealed by the water in the tank. The tank may be of any shape, or there may be no tank, the separated particles going to a waste pipe.

The greater the velocity of the rotor R the more efficient is the apparatus. A speed of 5000 ft. per min. is very practicable, but 10,000 is not excessive, either from the point of bursting or for any other reason.

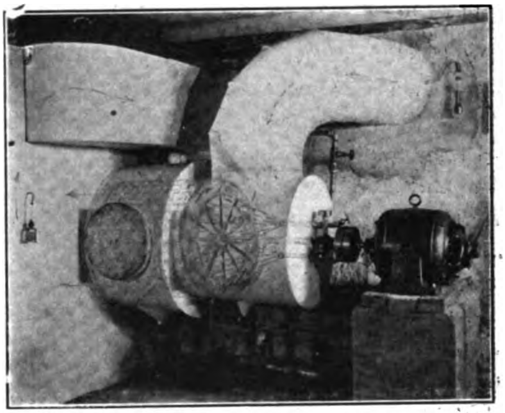

FIG. 3—APPLICATION OF APPARATUS TO CHIMNEY FOR REMOVING DUST FROM FLUE GASES.

The fan gives the same static pressure as any other centrifugal blower of equal diameter and speed and requires only equal power for equal work, and the power required for separation and friction is considerably under 25% of the blower power required to move the air.

The device as described above illustrates the principle of the various types of apparatus, whether used for taking the dust from the air, the CO_2 from a chimney or an enclosed space, the excess of humidity from the air, throwing down fog, cooling and moving air, etc. It will be noted that the ice in the upper tank serves both as a cooling medium and for the supply of cold water, broken into spray by the rapid motion of the fan, for the purification of the air.

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A. S. ARMAGNAC.................... *President*
GUSTAVE PETERSEN.... *Secretary and Treasurer*

A. S. ARMAGNAC, Editor
GUSTAVE PETERSEN, Business Manager
HAROLD L. ALT, Contributing Editor

European Representative:
W. G. HOLLINWORTH, 304 High Holborn
London, W. C.

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AMERICA is not awake to the war," cries the pessimist, as he throws open his office window to cool his overheated room and turns on another light. "We have got to realize that our industrial resources must be mobilized, as well as our men," he declares, finishing his day's work and walking out, leaving each radiator and electric light going at full blast. His evening paper tells him that there must be conservation of fuel and he marvels why people in these times can be so careless as to waste a single pound of coal.

Multiply this case by hundreds of thousands and we have a composite picture of what is happening in almost as many office buildings at this particular time. Conservation in general has meant little or nothing to most of us and fuel conservation not much more.

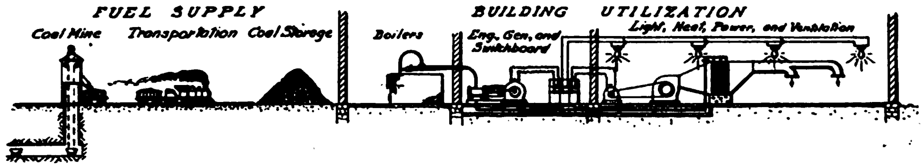
Suddenly there came the startling announcement, "The United States Face to Face with a Fuel Famine." How quickly we responded to that alarm and lost no time in getting in touch with our home coal dealer. The transition from passive interest to active concern was everywhere most striking.

In these last few weeks the country has realized that in this important matter the avenues of waste are appalling. While the campaign for a 68° F. indoor temperature will no doubt help, the great demand of the moment is for the prevention of wasted heat and light. Let every office-building tenant not only put a stop to this waste in his own office, but bring the matter to the attention of his building manager, so that there may be some concerted and uniform action in the matter. As one of the speakers said at a recent meeting of heating engineers, "It is a common sight to see great clusters of electric lights burning, in broad daylight, in many offices, while it is almost invariably the practice to leave radiator valves open all the time in offices and hotels, taking it for granted, apparently, that they are equipped with thermostatic control."

It is said that one-fifth of all our coal is wasted by firemen. No estimates are available of the amount wasted by the public in the form of radiator heat and electric light, but the figures must be colossal and afford a tremendous opportunity for constructive action.

ONE of the things the present agitation for fuel economy has brought out is the well-nigh universal practice in this country of purposely overheating the interiors of buildings. One of the slogans of the national Fuel Administration is "Help Save 1,000,0000 Tons of Coal," by reducing the indoor temperature to 65° F. It looks as if a war is necessary to bring the American people to its senses in this matter.

POWER PLANT ENGINEERING



Measuring the Feed Water

One of the most forceful arguments of all which are advanced from time to time against the small building power plant is that these plants are costing more to operate than the large central stations controlled by the public service companies. To a certain extent this is undoubtedly true, owing to the fact that larger plants employ units ten, twenty or even one hundred times the size of those in the building plant, thereby obtaining an efficiency of apparatus and an economy in operating force absolutely impossible for the smaller installation.

But the cost per kilowatt to produce by the central station is far from being the total cost, for to this must be added the expense of distribution and the company's profit which is often based on a stock and bond issue of more or less hydraulic variety. Even the expense of distribution alone is in most cases sufficient to throw the cost in favor of the smaller plant which has no franchise to pay for, no rights of way to obtain and practically no distributing system either to install or to maintain.

One investigator has made the assertion that if the public service companies could produce current in their central stations for *nothing,* the cost of distribution would still make the electric rate higher than if the current were produced by a reasonably economical plant installed on the premises. But the plant *must* be reasonably economical! So, in spite of this advantage, incompetent engineers and lack of proper upkeep often combine to render the smaller plant more expensive.

To make the small plant economical and to insure its being kept so, some good, accurate method of checking its performance must be used. The owner or agent operating the installation will be much more inclined to keep a competent engineer on the job and to maintain the plant in proper operating condition if it is possible to show him, or, better yet, if he, himself, can see at once the increased cost per kilowatt, and the decreased production due to such causes. Further than this, the operating engineer can keep better posted on the plant operation, on the conditions in the boilers and the method of firing for the particular quality of coal being used than by any amount of inspection and criticism of the firemen.

RESULTS OBTAINED BY MEASURING FEED WATER.

The simplest method of checking up a power plant in regard to securing maximum efficiency is by the measurement of the feed water, and a prominent manufacturer sums up the results so obtained as follows:

(*a*) It determines the boiler efficiency: that is, the number of pounds of water evaporated per pound of coal and, therefore, the number of heat units secured per pound of coal burned.

(*b*) It determines which method of firing produces the best results with the grade of coal being burned.

(*c*) It determines which fireman employs the most efficient method of firing and which man it is, therefore, most desirable to retain on the force.

(*d*) It determines which grade of coal—in relation to its cost—is the most profitable for the plant to use.

(*e*) It shows up deterioration of the grates or leaks in the boiler settings as soon as these become sufficiently serious to affect the plant efficiency.

(*f*) It indicates the loss of efficiency when the tubes scale up or the heating surfaces are allowed to become covered with soot.

(*g*) It exercises a great moral influence on the operating force being an incentive to each to make the best showing possible, resulting in a plant being kept in the very finest operating condition at all times.

The most popular apparatus to serve the

purpose outlined above is that termed the "V-notch recorder." The accuracy of this device is claimed to be within ⅓ of 1%, a smaller amount of error than obtained by any other economical means.

The V-notch recorder, installed as an entirely separate piece of apparatus, is shown in Fig. 1. In this cut the boiler-feed pump—instead of taking its suction directly from the feed-water heater—takes the water from the suction chamber of the V-notch recorder apparatus, as indicated by the arrows. This lowers the water level in the suction chamber and causes the float in this chamber to drop. This float controls the flow of water entering the apparatus from the feed-water heater through a shaft and rod connection to the lever-handled valve on the pipe running from the feed-water heater to the recorder.

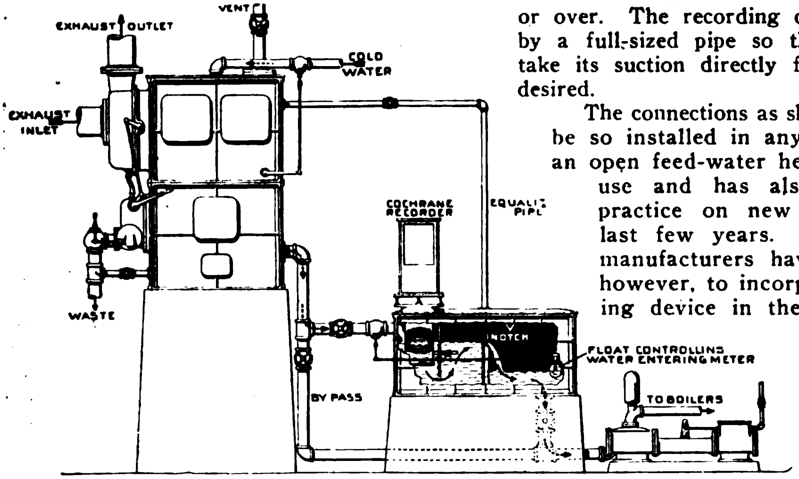


FIG. 1.—METHOD OF INSTALLING V-NOTCH METER IN CONNECTION WITH OPEN FEED-WATER HEATER.

The incoming water from the heater enters the inlet chamber of the recorder and flows under a baffle to the V-notch through which it spills into the pump suction chamber, previously described.

In the inlet chamber and enclosed within a hollow bottomless cylinder is placed a float which registers the height of the water on a clock-revolved time-chart in a manner similar to that employed to record steam pressures, temperatures, etc., by automatic recorders. This chart is graduated so that the area of the portion below the line marked thereon is transposable into the quantity of water, the height of the line being, of course, controlled by the height of the float and this in turn by the level of the water flowing through the V-notch.

The cold water coming into the system is admitted by the float in the feed-water heater just as usual and, in fact, no connections or piping are altered, as far as the heater is concerned, except the balance pipe which is run from the heater to the recording apparatus so as to prevent vaporizing of the feed water when heated to 212° F. or over. The recording device is by-passed by a full-sized pipe so that the pump can take its suction directly from the heater if desired.

The connections as shown in Fig. 1 may be so installed in any old plant where an open feed-water heater is already in use and has also been common practice on new plants until the last few years. Most open-heater manufacturers have now arranged, however, to incorporate the recording device in the heater construction itself. In such cases, the storage space in the bottom of the heater is utilized as the pump-suction chamber and the record float and recording device are installed in a little extension of the bottom portion of the heater somewhat as shown in Fig. 2, which is a view of the well-known Cochrane heater, so

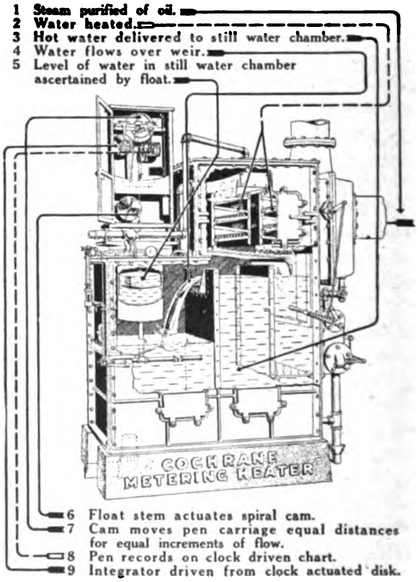

1 Steam purified of oil.
2 Water heated.
3 Hot water delivered to still water chamber.
4 Water flows over weir.
5 Level of water in still water chamber ascertained by float.
COCHRANE METERING HEATER
6 Float stem actuates spiral cam.
7 Cam moves pen carriage equal distances for equal increments of flow.
8 Pen records on clock driven chart.
9 Integrator driven from clock actuated disk.

FIG. 2.—COCHRANE HEATER, ARRANGED WITH PUMP SUCTION CHAMBER IN BOTTOM OF HEATER.

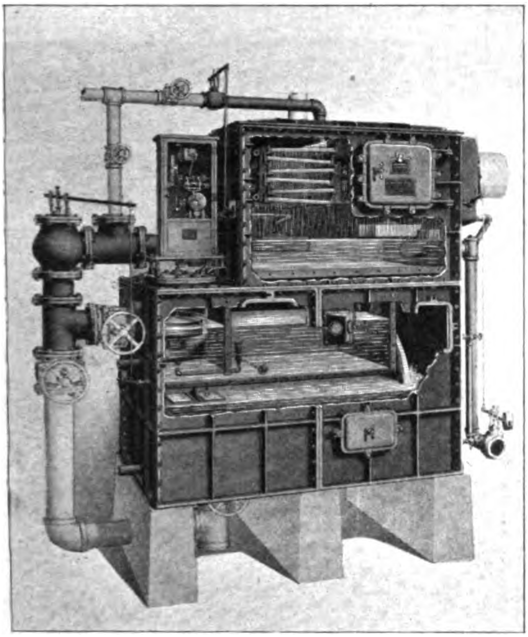


FIG. 3.—WEBSTER FEED-WATER HEATER.

arranged. The explanation of the separate apparatus will apply equally well to the combined equipment and the reader can readily trace the water flow by means of the arrows and notations on the cut.

The widely used Webster heater .does not employ quite the same arrangement, as can be seen by reference to Fig. 3, the water in this heater passing downward continuously from the time of its entrance until it reaches the pump suction chamber at the bottom, but the principle is identical.

With a closed heater, the separate apparatus first described is again used, as shown in Fig. 4, and it will be noted that the make-up water in this case is controlled by a second and lower float in the pump-suction chamber; also that in Fig. 4 the feed-water goes to the closed heater last, instead of first, as in Fig. 1. This arrangement is not as common as those employing the open feed-water heater.

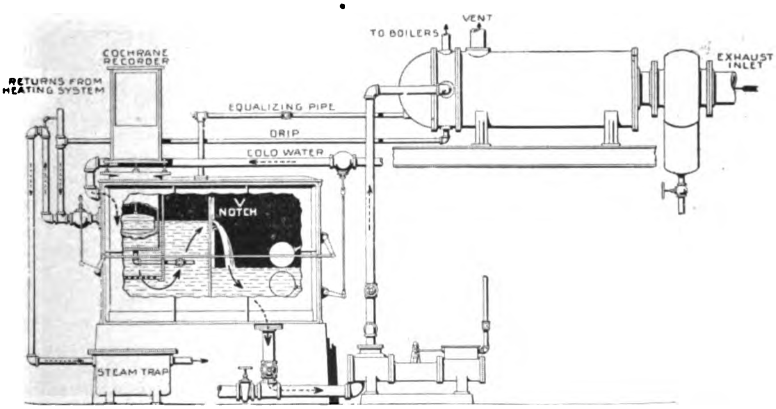
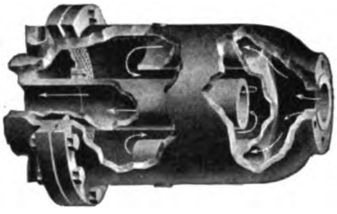


FIG. 4.—COCHRANE FEED-WATER METER ARRANGED FOR USE WITH CLOSED HEATER IN CONNECTION WITH EXHAUST STEAM HEATING SYSTEM.

NOTES

The Utility separator, made by the Standard Steam Specialty Co., New York, gives a storage capacity of steam at the throttle valve several times greater than the displacement of the piston. It is particularly desirable where the boiler and engine are separated by a considerable distance as it not only elminates the moisture in the steam but also catches all grit, scale, etc., which may be picked up by the steam in its passage through the piping system.



UTILITY STEAM SEPARATOR

The cut illustrates the vertical type of this separator, but it is also built for horizontal and angular connections.

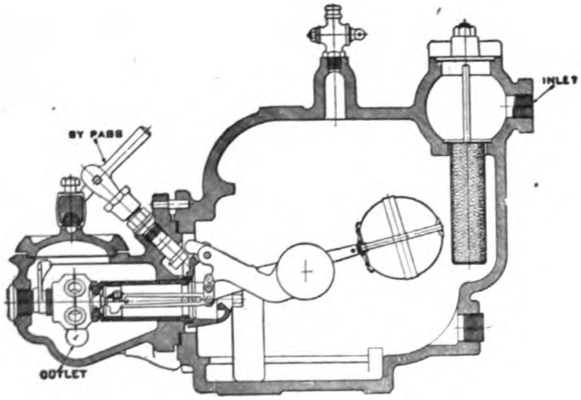
It is claimed that boilers troubled with scale—especially when caused by magnesia—will not only cease to form scale but will have gradually removed that already formed if a small amount of graphite is used with the feed water. The action on the magnesia in the water is to precipitate a mixture of magnesia and graphite in the form of a slime which may be easily washed out, while on the scale already formed the particles of graphite seem to work in between the scale and the steel, gradually loosening the scale as the treatment is kept up

In particularly bad cases the boiler should be inspected at the end of the first ten days and not less than every fifteen days thereafter for a couple of months. After that every thirty days will probably be sufficient.

The rising costs all along the line render the conservation of all materials most imperative. How many plants discharge their oily drips directly to the sewer? A very big percentage certainly! If this water is first passed through an oil-extracting tank a large percentage of the oil will be retained and can be re-filtered and re-used.

The extracting tank is a very simple proposition to build and can be cut into any oily trap discharge between the trap and the sewer. It consists simply of a tank large enough to insure a very slow velocity of flow through it and to serve as an oil recepter. Near the outlet end a baffle is placed, extending nearly to the bottom of the tank under which baffle the water flows to reach the outlet on the opposite side. Owing to the lighter specific gravity of the oil it will not sink and pass under the baffle to the outlet but instead is retained on the inlet side of the baffle and may be removed from time to time as fast as it collects in any quantity.

One of the well-known high and medium pressure drip traps on the market is the Anderson trap, made by the V. D. Anderson Co., Cleveland, O. The interior construction is illustrated herewith. The trap is provided with a water gage, bypass, air valve, blowoff valve and sediment strainer.



ANDERSON PRESSURE DRIP TRAP.

The "Model D" traps are made in five sizes to operate against any back pressure which is 5 lbs. less than the pressure at the inlet of the trap.

CORRESPONDENCE

Hot Water Heating Connection to Garage.

EDITOR, HEATING AND VENTILATING MAGAZINE:

I desire to install a hot water heating system in a garage, and to supply it from the hot water system in the house. The garage stands approximately 30 ft. from the house and requires a radiator of 125 sq. ft. surface; I expect to run the circulation lines over to the garage and back, placing these lines in wrought-iron pipe, pitched up toward the garage.

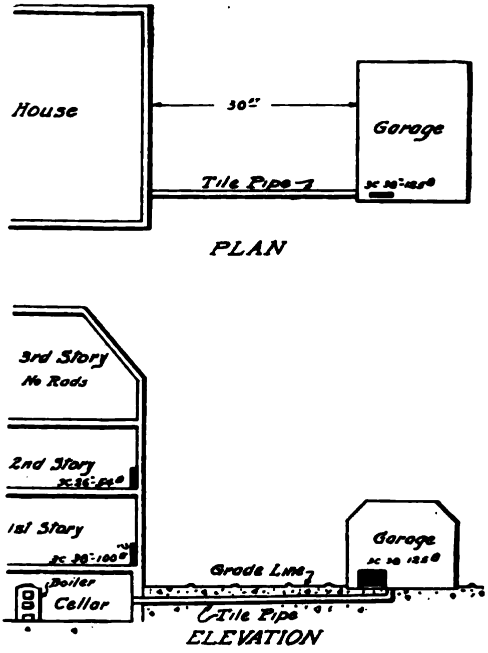


FIG 1.—PROPOSED ARRANGEMENT FOR HEATING GARAGE.

The general conditions are indicated in the sketch of the plan and elevation accompanying this letter, the house being a three-story dwelling with no radiators on the third floor. The question on which I desire your help is whether you would run the hot water supply line to the third floor, then back down and across to the garage and, if so, would you put an air vent on the top of the loop? What kind of a vent would be most suitable? If not, would you run the supply up to the second floor radiator and then down and over to the garage?

Pittsburgh, Pa. H. W. A.

Our correspondent's sketch is shown in Fig. 1, except that the wrought-iron pipe he mentions has been changed to tile pipe which is much better for this sort of work. Both of his suggested schemes of circulation are good. It is a well-known fact that to circulate across a long, horizontal distance to another building some vertical rise is necessary in order to produce sufficient head to circulate the water.

If the line is carried up to the third floor level and then dropped back, as suggested by our correspondent, a high point is produced in which air will collect and this air must be gotten rid of from time to time to avoid its stopping the circulation. An air chamber about 12 in. or 18 in. high and of pipe two or three sizes larger than the circulation line may be used as a receiver for this air, and a common air valve mounted on the cap on top of the pipe will serve to relieve this accumulated air from time to time

This, of course, is not automatic in operation and the substitution of certain types of automatic air vents which "relieve air under pressure" might give better satisfaction As the difference in the weight of the two columns of water (in the pipe going up and the pipe going down) is dependent on the temperature difference and height, it follows that the pipe carried up to the third floor level will give better results than one only carried to the second floor and vented into the radiator On the other hand, the radiator furnishes an automatic method of ridding the loop of air and has an advantage in this respect

Our suggestion, however, would be to make the connections as shown in the sketch, Fig 2 While our correspondent does not specifically so state, we assume his house system is a gravity system with an expansion tank at some high point If this is the case, a small air relief pipe taken from the top of the loop and graded constantly up from the top of the loop to the point of its connection to the expansion pipe, just below the tank, will give the required air relief automatically without the use of any special devices This has been illustrated in Fig 2.

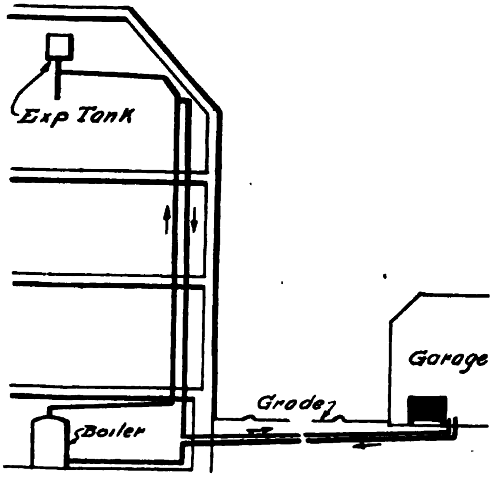


FIG 2.—SUGGESTED METHOD FOR HEATING GARAGE.

In case this arrangement is impossible, either on account of the use of a pressure system, or for other reasons, we recommend running the loop up to the third floor and venting, as before suggested.

Formulas for Figuring Pipe Capacities.

EDITOR, HEATING AND VENTILATING MAGAZINE:

Will you kindly give me formulas for finding the quantity of air, water, and steam delivered per minute through a pipe, neglecting friction, when pressure and size of pipe is known.

Utica, N. Y. C. A. C.

The flow of water through pipes when the friction is neglected practically becomes the flow through an orifice of the same size and diameter as the pipe, since the pipe is only a continuation of the orifice for a definite or indefinite length. This is incorrect and impractical for pipe work, since even a short length of pipe will cut down the velocity and, therefore, the quantity flowing to a very large extent.

The only practical way of figuring pipe sizes without regard to friction is to assume a velocity in the pipe which will produce only a reasonable amount of friction, or drop in pressure, and then to compute for the area of the pipe, or vice versa. In such cases the formula used is

$$Q = \frac{AV}{144} \text{ or } A = \frac{144Q}{V} \text{ or } V = \frac{144Q}{A}$$

when Q = quantity delivered in cubic feet per minute
V = velocity of flow in feet per minute
A = area of pipe in square inches, or $0.7854\,D^2$ when
D = diameter of pipe in inches
144 = number of square inches in a square foot

Q for water is usually left in cubic feet or multiplied by 7.5 to transform it into gallons per minute.

Q for air is usually reduced from the

cubic feet per minute (at the pressure in the line) to pounds of air or to cubic feet of free air.

Q for steam is usually reduced from the cubic feet per minute (at the pressure maintained in the line as shown by steam tables) to pounds of steam per minute.

To apply the above, assuming an 8 in. pipe and 50 lbs. pressure with a velocity for water of 200 ft. per minute, of steam as 5,000 ft. per minute and of air as 5,000 ft. per minute, the deliveries are as follows:

The area in square inches of an 8-in. pipe = 50 (about)

For Water

$$Q = \frac{50 \times 200}{144} = \frac{10,000}{144} = 69.4 \text{ c.f.m.}$$

$$69.4 \times 7.5 = 520 \text{ gal. per minute.}$$

For Steam

$$Q = \frac{50 \times 5,000}{144} = \frac{250,000}{144} = 1700 \text{ c.f.m. apx.}$$

Weight of 1 cu. ft. of steam at 50 lbs. gauge (see steam tables) = 0.15 lbs.

$$1700 \times 0.15 = 255 \text{ lbs. per minute.}$$

For Air

The *cubic feet* per minute would be the same as for steam at the same velocity, but the weight of 1 cu. ft. of air at atmospheric pressure and 62° F., is 0.076 lbs. (See tables on "Properties of Air.") The temperature of the air (both at 50 lbs. pressure and atmosphere) remaining the same, the relative volumes may be computed from the formula:

$$P_1 V_1 = P_2 V_2$$

when P_1 and V_1 are the absolute *pressure* in pounds per square inch and *volume* in cubic feet in the first state and P_2 and V_2 the absolute pressure and volume in the second state.

Therefore, if the pipe delivers 1700 c.f.m. of air at 50 lbs. pressure, the volume of free air at the same temperature will be

$$P_1 V_1 = P_2 V_2$$

$$(50 + 14.7) \times 1700 = 14.7 \times V_2$$

$$\frac{64.7 \times 1700}{14.7} = V_2$$

$7500 = V_2$ or cubic feet of free air per minute and

$$7500 \times 0.076 = 567 \text{ lbs. of air per minute.}$$

For the flow of steam, water and air through an orifice the correspondent is referred to the numerous formulæ and tables contained in Kent's Engineers Pocket Book.

The War and the Heating Engineer

Lower Indoor Temperatures as a War Conservation Measure.

Acting on the suggestion of Dr. Garfield, the fuel administrator of the country, that people reduce the temperature in their homes and offices a few degrees in order to reduce the heating requirements and thereby save a vast amount of coal, the Illinois Maintenance Company, of Chicago, acting for the Illinois State fuel administrator, has sent out a letter strongly seconding Dr. Garfield's suggestion. Accompanying the letter is a tag, reproduced herewith, to be placed on thermostats or above the radiator to act as a remainder.

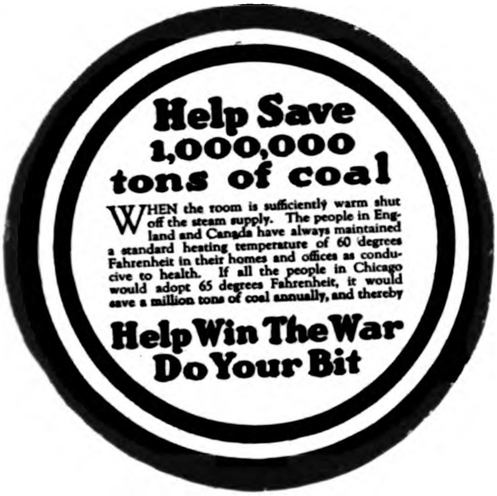
The letter is substantially as follows:

The usual standard of temperature for homes and offices in this country has been from 68° to 70° F. A great many buildings exceed this temperature, and temperatures of 75°, 80° and 85° F. are not uncommon.

If people in Chicago would accustom themselves to an indoor temperature of 65° F., and maintain that tempeature by steady regulation of the steam supply there would be a saving of at least 15% of the fuel required for heating interiors, or a saving of about 1,000,000 tons of coal annually right here in Chicago.

Dr. E. Vernon Hill, chief of the Ventilating Division of the Chicago Health Department, says that the ordinary individual can easily become accustomed to this temperature, provided a sufficient amount of clothing is worn, as has been clearly demonstrated by the experience of England, France and Canada, and by the general consensus of opinion of physicians and heating experts throughout the country.

Dr. W. A. Evans, formerly Health Commissioner of Chicago, and a well-known writer on such topics, states as follows:



Help Save 1,000,000 tons of coal

WHEN the room is sufficiently warm shut off the steam supply. The people in England and Canada have always maintained a standard heating temperature of 60 degrees Fahrenheit in their homes and offices as conducive to health. If all the people in Chicago would adopt 65 degrees Fahrenheit, it would save a million tons of coal annually, and thereby

Help Win The War Do Your Bit

TAG SENT OUT BY ILLINOIS MAINTENANCE COMPANY.

> "Any number of experiments have shown that low temperatures, 60° to 68° F., as compared with the high temperatures which so often prevail in office buildings, school rooms and living places (70° to 85°) are favorable to health. For instance, a person staying for an hour in a warm room is certain to develop about a degree of fever. This leads to colds, infections generally, anemia, fatigue and general rundown conditions."

If Chicago will set the example, other cities will follow, and we will save not only 1,000,000 tons of coal here, but also several millions tons of coal throughout the country. This would conserve the coal for military purposes, and also bring down the cost, thus reducing the suffering among the poorer classes.

Will you not instruct the engineer to adjust the thermostats in your offices to not exceeding 65° F. so as to help along this movement and thus help win the war?

Store Savings in Fuel.

Four specific ways in which retail merchants can reduce the consumption of coal by economy in lighting are recommended by the Boston Chamber of Commerce.

1. Lights may be turned off at 8 p. m., or at the time of closing.
2. Electrical advertising signs may be discontinued.
3. The amount of heat, light, and power used in retail stores may be reduced by general effort.
4. Lights in show cases need not be turned on until 10 a. m.

General reductions of coal consumption may be effected by maintaining store heat at 65° F. or less, reducing the candlepower of electric lamps where a smaller lamp will answer every purpose, and replacement of old, blackened, current-wasting lamps whenever found.

The Watchman Evil.

The prevailing custom among manufacturers, warehousemen and others is to engage as night watchmen superannuated employees who are no longer able to earn a workman's pay. At the recent New Orleans convention of the Fire Marshals' Association of North America, it was voted to sound a warning to manufacturers and warehousemen that, especially in these times, watchmen should be picked men and not derelicts. They should also be sufficient in number to furnish real protection and they should be armed. They should receive special training for their important duties and this training should include knowledge of fire alarms, fire prevention and fire protection. They should never be engaged except upon unmistakable evidence of character, and they should be paid the salaries that will command such qualifications.

Paying for Liberty Bonds.

On November 15, which was the date on which the first installment on Liberty Loan Bonds was due, approximately $2,400,000,000 was paid in, although less than a third of that amount was due.

In other words, nearly two-thirds of the aggregate subscriptions to the Second Liberty Loan have been paid in full, the purchasers not availing themselves of the right to wait until December 15 and January 15 to make their other payments.

Growth of Federal Reserve System.

Between the dates, November 1 and November 16, 1917, State banks and trust companies, whose aggregate total resources are $845,796,400, were admitted to the Federal Reserve System.

The Responsibility of Science for War Horrors.

"Unless some conscience is aroused that science is not to be used against man, but for him, then it will never be safe for this world," said Dr. Ira N. Hollis, retiring president of the mechanical engineers' society in his recent presidential address. "It is our task," continued Dr. Hollis, "to assist in making the world safe against the forces that we have unloosened, so that the century may not close with a total failure of the civilization of Christian races. It is we who have developed the application of science, and it is we who are using it to destroy one another, forced into the struggle by the rulers of a nation that knows no right except might, and no mercy except that which is taught them by the sword.

"The twentieth century is still young, and we do not yet know what it will represent to the future historian. Will it be the debauch of science or will it mean a new birth to Christianity? It is the engineers' task to decide this. There are two tendencies; one toward greater comfort and luxury, and one towards greater service. The first can plunge us only deeper and deeper into war for the control of a commercial output. It can only bring us more firmly under a governing class devised either by birth or by commercial success. The second means the complete emancipation of the individual trained to think of service as the chief source of good government and happiness in life. The only theory that will hold men together is that of service."

Engineers Serving Government in War.

How the 30,000 engineers represented in the great technical societies of this country are quietly serving the government in performing all manner of duties—confidential and otherwise, was disclosed at the convention of The American Society of Mechanical Engineers by Gano Dunn, chairman of the Engineering Committee of the Council of National Defense. Mr. Dunn said the government had made numerous and various calls upon engineers for service, and there is not yet on record a single case in which the government has asked an engineer to perform a service and the service has not been promptly and faithfully rendered.

Mr. Dunn related how at the outset of our war the Government soon used up its own resources of professional men and fell back upon those of the great technical societies which responded patriotically to their new duties and opportunities. He said that the United States is not really in the war yet and he expected the time to come shortly when all the engineers of the nation would be needed for service. He said the engineers stood ready to respond, even as numbers have already responded by severing all their business connections and sacrificing their incomes.

Preparations for the Third Liberty Loan.

According to present estimates, the third Liberty Loan will be undertaken the middle of February or the first of March. The amount of money to be raised is much greater than was raised in both of the previous loans and the call upon the country's resources and upon every citizen will be greater than ever.

In an effort to promote thrift and self-denial in this country at the present time, it is authoritatively stated that our war bills, growing heavier as the climax of the world contest draws nearer, cannot be met by the same measure of thrift that characterized the first months. The United States must reach and surpass the mark set in France and Great Britain. In England, one bank alone, the London City and Midland, reports that its depositors applied for $451,198,000 of the last war loan, or considerably more than one-half the amount standing to their credit. This may give an insight into the compelling pressure of patriotism upon all classes of persons in England, for the London City and Midland reaches all social ranks. It must not be supposed that these English subscribers drew all their half-billion from the bank in order to pay for their bonds. Such a step would have resulted in grave trouble. This tremendous total could not have been lent to the Government without the most extraordinary thrift and self-denial.

Organization of Central War Industries Committee.

One of the principal actions taken at the recent conference of the Chamber of Commerce of the United States, held in Washington, December 12, was the creation of a central war industries committee of the National Chamber, with Waddill Catchings as chairman. The convention voted that where there are at present war service committees they be requested to ask recognition of the war committee of the National Chamber and it was provided that if they are organized in conformity with this report, that they be so recognized.

All existing national trade organizations or associations which have not already appointed war service committees are requested to do so immediately. All such war service committees are to be vested with authority to represent the industries in their relations with the government during the war. In this way a close touch will be maintained with producers in the various lines, with data on individual concerns that are able to carry out the necessary contracts. The war service committees are also to act as clearing houses as to available plant capacity, notifying the government of the facts ascertained in order that needless expenditures for additional plants and equipment may be avoided.

The Boiler and Radiator Manufacturers' Association met in New York, December 10, to appoint a war committee to represent this industry.

New Food-Saving Suggestions.

To the wheatless and meatless days has been added a porkless day and to each day a wheatless and a meatless meal. The consumer is urged to use sugar on the basis of 3 lbs. per person per month. As a nation, states the Food Administration, we eat and waste 80% more protein than we require to maintain health and, therefore, we can reduce the amount of meat we eat without harm. We eat and waste 240% more fat than is necessary. New home food cards have been issued by the Food Administration, containing these additional suggestions.

On the reverse side of the card it is stated that "the food situation in Europe is far graver than when the preliminary survey of the food supply of the world for 1917 was made. We have an abundance for ourselves, but food has now taken a dominant position in the war and the American people are asked to sacrifice far more than was at first thought necessary. All of the surplus wheat from the 1917 harvest has already been exported, so that any additional wheat or its products that the allies receive from the United States from now on will be exactly the amount which our people have saved each month.

War-Savings Certificates.

Attention is called in a new Treasury Department circular (No. 94) to the war-savings certificates, series of 1918, which were recently placed on the market. The sum of certificates outstanding at any one time is limited to $2,000,000,000, while the amount sold to any one person at any one time is limited at $1,000. This is done to secure as wide a distribution as possible. As is generally known, each certificate has spaces for 20 war-savings stamps, each of which will have a maturity value of $5.00 on January 1, 1923, making the value of the certificate at that time, when filled with stamps, $100.00.

The prices of the stamps range from $4.12 in Januay, 1918, to $4.23 in December, 1918, so that the average issue price fixed for the year 1918, with interest compounded quarterly, will amount to $5.00 in January, 1923.

As an easy method of saving money for the purchase of war-savings certificate stamps, the government has issued thrift stamps, having a face value of 25 cents. These are to be affixed to Thrift Cards, both being obtained from the post-office, bank or other agency. When sixteen Thrift Stamps have been affixed, the card may be exchanged for a war-savings certificate stamp by the payment of a small exchange, all of which has been carefully figured to give the purchaser 4% compound interest on his investment.

Old Tracings for Bandages.

The use of old tracings for bandages has proved so successful that the Red Cross has asked its 3,000 chapters throughout the United States to co-operate in the work. Tracing cloth is a very fine quality of linen and is easily made available for bandages by putting it through a laundry. Business concerns with drafting offices are asked to gather up their discarded tracings and send them to the nearest Red Cross branch.

Heating Men in Military Service.

Captain C. L. Collette, formerly with the Kewanee Boiler Co., has recently been awarded special honors for marksmanship at Camp Grant, Rockford, Ill.

John B. Thomson, architect, and Norman B. Thomson, a senior in Penn State College, both sons of T. N. Thomson, of Scranton, Pa., have enlisted in the aviation corps and are in training at Fort Sam Houston, Texas.

A. W. Mills, formerly western representative of the Haydenville Co., Haydenville, Mass., has been commissioned an ensign in the merchant marine. He has charge of the guns and gunners on one of the armed merchant vessels.

Allen B. Stiles, of Crane Co., Chicago, has been commissioned a lieutenant of artillery in the National Army. He is at present acting as aide to Brigadier-General Henn.

C. C. Vaughn, president of the Lytton Mfg. Corporation, Franklin, Va., has been commissioned a brigadier-general in command of the Virginia State troops. General Vaughan served as captain of militia in the Spanish-American War and at the opening of the present war was brigadier-general of the Virginia volunteers. He comes from a family of soldiers, his father having served in the Confederate Army throughout the Civil War, while direct ancestors of General Vaughan served in the War of 1812 and in the Revolutionary War. His son, Cecil C. Vaughan III, is a first lieutenant of the Virginia troops.

New York Steam Company's Rates Reviewed by Public Service Commission.

In a recently-instituted rate proceeding, the New York Public Service Commission for the First District, has undertaken, among other things, to determine the question of the effect of the New York Steam Company's new schedule which was filed with the commission on 30 days' notice and which became effective June 1, 1917, on unexpired term contracts.

According to this schedule the company renders its service under five rates: Rate A, for general service; Rate B, for annual power service; Rate C, for apartment house service; Rate D, for summer power service; and Rate E, for auxiliary or emergency heating service. In all of these rates the unit of heat is a kal, which is 1 lb. of water evaporated into steam or 1 lb. of steam condensed into water.

The rate for general service (Rate A) for the first 20,000 kals consumed in each monthly period is $1.50 per 1000 kals; for annual power service (Rate B) for the first 500,000 kals consumed in each monthly period, $0.60 per 1000 kals; for apartment house service (Rate C) $0.60 per 1000 kals for all steam condensed, with a minimum of 100,000 kals; for summer power service (Rate D) for the first 500,000 kals consumed in each monthly period, $0.55 per 1000 kals; and for auxiliary or emergency heating service (Rate E) for the first 20,000 kals consumed in each monthly period, $1.50 per 1000 kals. All of these rates, except in the case of apartment house service, are subject to the usual reductions for increased steam consumption.

The principal matter that came before the commission for determination was the effect of the company's new schedule on service contracts which had not expired at the time the schedule went into effect. Most of the customers holding these unexpired contracts became convinced that they were abrogated by the new schedule, but one customer appealed to the commission.

He was informed by the secretary of the commission that the company's new schedule "is the lawful charge for service from the date it became effective," but "it is not considered that it gives the steam company the right to abrogate term contracts. Where the commission, after an inquiry and a determination, by order, fixes a rate it has held that the rate so fixed has the effect of abrogating term contracts, but in the case under discussion the rate is that filed by the company on its own motion."

In a memorandum prepared by the steam company it is pointed out that the case is not one of first impression, as "the law was well settled ten years ago in Armour Packing Co. v. United States, (209 U. S. 56) and the rule laid down in that case has since been iterated and reiterated by the courts."

The point is also made in the memorandum that the hearing is futile because the commission has no power to make any order directing the steam company to perform unexpired contracts. Arguments are also made to prove that a schedule filed voluntarily by a public service corporation has, for all purposes, the same force and effect as a schedule filed under an order of the commission prescribing its terms.

It is further pointed out that the authorities are uniform that all service contracts of a public utility are made subject to a lawful change in the rate, although that change may have been voluntarily effected by the utility itself.

In conclusion, the New York Steam Company asks that the supplementary proceeding be dismissed and that the opinion expressed by the secretary repudiated.

The commission's decision and opinion are being awaited.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Preparations for Annual Meeting.

Two evening sessions, in addition to the daily sessions, have been arranged for the annual meeting of The American Society of Heating and Ventilating Engineers, to be held at the Engineering Societies Building, New York, January 22-24. Following is the schedule:

TUESDAY, JANUARY 22.

Business session, 2 p. m.
Drying session, 8 p. m.

WEDNESDAY, JANUARY 23.

Fuel Conservation session, 2 p. m.
Hearing on Boiler Testing Code, 8 p. m.

THURSDAY, JANUARY 24.

Furnace session, 10 a. m.
General professional session, 2 p. m.
Annual dinner, 7 p. m.

A joint committee of the society and of the New York Chapter will have charge of the social features of the society's forthcoming annual meeting, to be held January 22-24, in the Engineering Societies Building, New York. This committee is headed by R. W. Pryor, Jr. The chairman of the various sub-committees are: Finance, P. H. Seward; information bureau, H. G. Issertell; ladies, W. H. Driscoll; dinner, B. H. Strader.

Arrangements have been made to hold the annual dinner of the society in the Belvidere Room of the Hotel Astor on the last evening of the meeting, January 24, instead of on the second evening.

New Chapter Organized in Minnesota.

A new chapter of the American Society of Heating and Ventilating Engineers has been organized in Minneapolis, Minn., to be known as the Minnesota Chapter. At a meeting, held at the Minneapolis Athletic Club, a preliminary organization was effected by the election of Professor John R. Allen as temporary chairman and Harry E. Gerrish as temporary secretary. Those present at the meeting were Prof. John R. Allen, Charles L. Pillsbury, Albert Martin, Donald Forfar, Glenn C. Morgan, Robert Otto, George Atherton, Hans J. Meyer and Harry E. Gerrish.

It was decided to appoint a committee to draw up a constitution and by-laws and to compile a list of prospective members to strengthen the petition to be forwarded later to headquarters for a chapter charter. It was estimated that the membership in Minneapolis and vicinity could be increased 300% to 400%.

At a subsequent meeting held December 7, with the local chapter of the American Institute of Electrical Engineers, the subject of central station was taken up, the discussion being opened by Professor Allen.

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New York Chapter Given Data on High-Temperature Drying.

A notable review of the development of high-temperature drying and of the possibilities in this direction was given in an address delivered by Burt S. Harrison, at the December meeting of the New York Chapter. The meeting which was held at the Building Trades Club, New York, December 17, was in charge of a committee headed by W. F. Goodnow.

Mr. Harrison read from a carefully-prepared manuscript which proved to be full of practical notes on the subject gleaned from a long experience in many lines of drying work. At the conclusion of his address it was voted unanimously to turn over the paper to the society with a view to having it presented at the annual meeting or at least published in the society's Journal.

One of the points brought out by Mr. Harrison was that such foods as potatoes are apt to turn dark on being dried and while this does not harm them as a food, they do not present so palatable an appearance, with the result that in commercial practice they are often adulterated with a bleaching agent, containing sulphuric acid, which is distinctly injurious to health. He said more pure food laws were needed to make the field successful for wholesome dried fruits and vegetables.

He also spoke of the difficulties encountered when manufacturers change the conditions in connection with the drying of their products after the preliminary tests are made and in some cases, the apparatus installed.

The presence of static electricity in the hot air is an important matter frequently resulting in charging fabrics and gums. Ozonized air is of little avail in this connection and electric conductors are too expensive.

Air at high temperatures has high transmission losses, running as high as 3 B.T.U.

per square foot per degree difference and for this reason it is advisable to use trunk lines of ducts, as far as possible, and to take off the branches at one point.

In making the joints of an air-tube heater tight, Mr. Harrison said the best combination was a mixture of Portland cement and buttermilk. He advocated the use of steel-plate fans for drying work in preference to multi-blade fans, a statement that was endorsed in the ensuing discussion by J. I. Lyle.

The best fuel for use with air-tube heaters, he found, was a high grade of crude oil.

In response to a question Mr. Harrison stated that he did not consider that the small, individual drying units for household use would go very far in nationalizing the dried food industry. While these units are capable of drying the various products, their preservation is another matter and unless they are dried under the proper conditions they are subject to mold and other troubles. In his opinion the only way to dry foods successfully on a national scale is to establish central drying plants to be operated by experts where the farmers may bring their produce.

Previous to Mr. Harrison's address H. G. Issertell, acting as a member of the national Red Cross committee, made a plea for the support of the members in the drive for 10,000,000 members by Christmas Eve. Forty members and guests were present.

Professor John R. Allen Addresses Illinois Chapter.

"What We Do and What We Don't Know About Heating" was told by Professor J. R. Allen at the December meeting of the Illinois Chapter, held at the Engineers' Club, Chicago, December 10. Professor Allen, who is now dean of the College of Engineering and Architecture at the University of Minnesota, brought greetings from the Minnesota Chapter of the society, which has just been formed. He then spoke at length on the subject of heating constants, basing his remarks largely on the tests that have been conducted at the University of Michigan for heat losses through a specially-constructed testing room which was subjected to a variety of conditions of wind and rain (see THE HEATING AND VENTILATING MAGAZINE for August, 1916). As a result of these experiments, he said, he is now using a constant of 1.25 for glass.

"We need in this country," said Professor Allen, "a vast amount of experimental research so as to place these fundamental constants of the heating business on a well-established foundation." He believed, however, that it will never be possible in heating work to entirely eliminate the factor of judgment, due to the many variables entering the problem, such as the conditions of building construction, and materials used.

Kansas City Chapter Discusses Wind Leakage and Domestic Water Heating.

Addresses by H. W. Whitten on "Wind Leakage and Its Effect on Heating and Ventilation" and by W. W. Howe on "Heating Hot Water for Domestic Purposes" were presented at the December meeting of the Kansas City Chapter, which was held December 7 at the University Club. In the absence of W. N. McIntyre, chairman for this meeting, the subject of wind leakage was handled by H. W. Whitten. So much valuable information was contained in Mr. Whitten's talk that it was voted to have the data compiled by a special committee, consisting of R. F. Taylor and W. W. Downes.

Some of the points brought out by Mr. Whitten were as follows:

The average window or door has a free opening around its sides directly connected with outdoors and about 20 ft. in length. The width of this opening is usually such that its total area is about the size of a brick. In other words, each window or door is equivalent to a hole the size of a brick or shingle, leading directly outdoors. When there is no wind, this condition is not so serious, but when the wind blows, the effect is as follows:

Heretofore people have assumed that it was necessary to thus protect the north side only, but exhaustive tests have shown, with a wind from the north, that on the leeward or south side of the house, a suction was created, thus causing an outflow of heat through the cracks in the windows and a corresponding heat loss, due to outflow or loss of warm air going out. Air leakage, therefore, is due to inflow of cold air from the window pressure and outflow on leeward side, due to a partial vacuum and air expansion. Both have a corresponding effect on the loss of heat, and this shows the fallacy of weatherstripping only part of the house.

Warm air expands in all directions and the expansion of warmed air in the building will keep out most of the cold drafts until the wind rises above six miles per hour. On the other hand, the wind blowing around and over a building causes a suction or partial vacuum on the sheltered sides of the building, and this suction pulls on every open crack. The inside air, warmed and expanded, is trying to escape, just as it would from a hot air balloon, and is assisted by the suction action of the outside wind, the result being that the heat loss on the sheltered side, window for window and door for door, will be about 20% greater than the loss on the exposed side, due to the suction above mentioned. Effective weather-stripping will practically eliminate this loss.

In addition to the regular programme P. W. Thomas, fuel engineer, of the Central Coal & Coke Company, presented suggestions for fuel conservation. The coal situation, he said, has become almost a national crisis. Kansas City proper is well taken care of in the matter of coal supply because of early storage in the yards, but the Southwest as a whole is not so fortunate. Kansas City users of coal should be careful of heating plants, not so much because of conditions in the city as because the tonnage saved there means that the smaller towns in Kansas, Missouri and Nebraska will get coal. Even cities such as St. Paul, Minneapolis and St. Louis and Chicago are begging for coal from the Arkansas field.

In the Kansas City section of the country, a simple method of conservation is to order Arkansas semi-anthracite lump to mine-run grades. The mine-run, said Mr. Thomas, is a good domestic fuel, practically equal to the lump in heating power and lower in price. It carries an additional appeal in that every ton produced at the mine goes into the domestic trade. For every ton of screened or forked lump coal that Kansas City burns, some steam plant consumes three tons of the same coal. This is not because the mine-run is 75% slack—but because the lump coal cannot be handled without breakage. Accordingly, of 100 tons screened at the mine, fifty tons of lump may be shipped to Kansas City, the other fifty tons being shipped as slack to a steam plant. The fifty tons of lump, arriving here, is so broken by transportation that, on being forked, twenty-five tons more fine coal of the same heating power as lump, for it is crushed lumps, is thrown to the steam trade, leaving twenty-five tons of the original 100 as lump.

The ironical condition is that this lump, after being dropped into the basement of the purchaser, is again reduced to half lump, half slack, by picks and hammers. In other words, many users of coal are paying for lump, receiving it, and after causing a shortage of three tons of coal to the domestic trade, are taking a sledge, pick or hammer and reducing this lump to a grade that they could have bought direct at a lower price.

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British Institution of Heating Engineers.

At the autumn meeting of the Institution of Heating and Ventilating Engineers, held in London, October 9, Edgar Herring, of London, was elected president, to succeed Sam Naylor. F. Biggin, of Sheffield, was elected vice-president.

The principal paper presented at the meeting was on "Temperature Records under varying Climatic Conditions," by Walter Jones. This paper described some experiments which had been made by Mr. Jones in his own residence and in two of his business offices. Records were made of the outdoor and indoor temperatures at regular intervals and of the fluctuations of the temperature of the hot water used in the heating systems. As a general rule in the house tests, it was found that for each degree drop in temperature outside, an increase of 2° F. in the water temperature was sufficient to keep up the room temperatures. It was also shown that the lowest water temperature recorded, 100° F., and the highest, 160°, proved that the boiler capacity and the amount of radiation were sufficient.

A report of the progress of the research work at University College was presented by A. H. Barker, illustrated by lantern slides, showing many of the methods adopted and the delicate appliances which had been installed. Mr. Barker asked the members to further the movement to raise the necessary funds so that the institution could obtain the proposed Government grant of £450 for research work.

The annual general meeting of the institution will be held in London, February 12.

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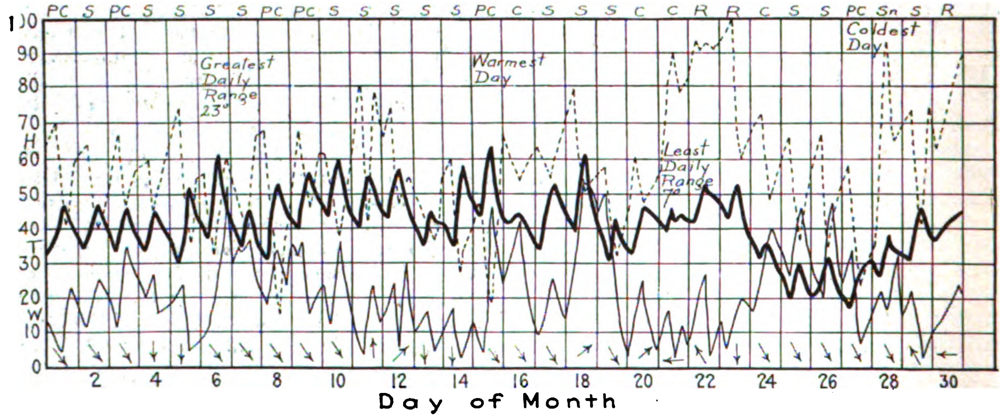
Annual Meeting of American Society of Mechanical Engineers.

War topics predominated at the recent annual meeting of the American Society of Mechanical Engineers, which was held in New York, December 4-7, 1917. Methods were also considered whereby the problem of fuel conservation will be met, either by compelling coal consumers to execute such measures of economy as the authorities prescribe, or else by disseminating correct information regarding the mining and consumption of coal, accompanied by an appeal to the patriotism of consumers.

Charles T. Main, of Boston, a consulting engineer, was elected president of the society.

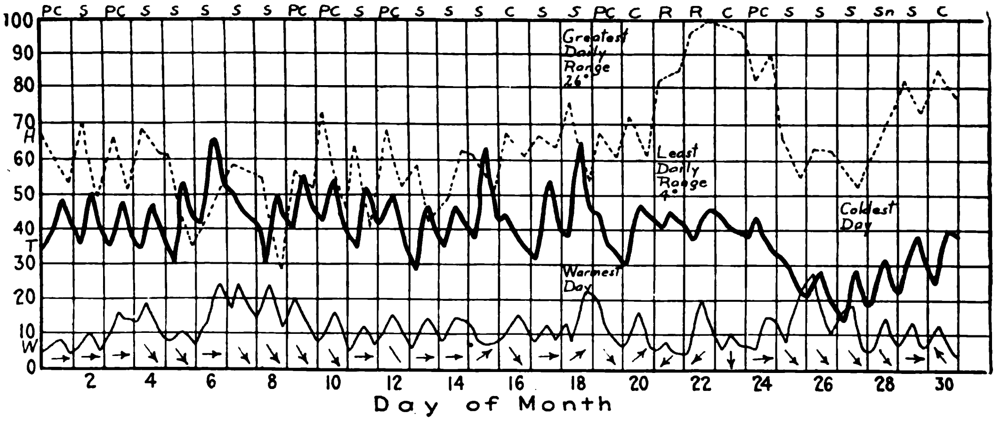
The Weather for November, 1917

	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest temperature, degrees F	63	65	64	69	74
Date of highest temperature	15	18	6	17	7
Lowest temperature, degrees F	18	13	19	22	24
Date of lowest temperature	27	27	25	24	24
Greatest daily range, degrees F	23	26	28	23	32
Date of greatest daily range	6	18	9	15	3
Least daily range, degrees F	7	4	4	3	3
Date of least daily range	21	21	28	28	28
Mean temp. for month, degrees F	41.2	39	40	43.1	47.4
Normal mean temp. for month, degrees F	44	41.2	42.9	39.2	43.4
Total rainfall, in	0.68	0.59	0.28	0.56	0.78
Total snowfall, in	0.3	2.2	1.0	1.5	
Normal precipitation, this month, in	3.44	4.1	2.55	2.5	2.88
Total wind movement, miles	15519	7836	6438	7728	7427
Average hourly wind velocity, miles	17.4	10.9	8.9	10.7	10.3
Prevailing direction of wind	N.W.	N. W.	N.W.	N.W.	N.W.
Number of clear days	16	16	9	12	11
Number of partly cloudy days	7	7	8	4	6
Number of cloudy days	7	7	13	13	13
Number of days on which rain fell	4	2	4	1	5
Number of days on which snow fell	1	1	2	4	None
Snow on ground at end of month, in	None	Trace	None	None	None

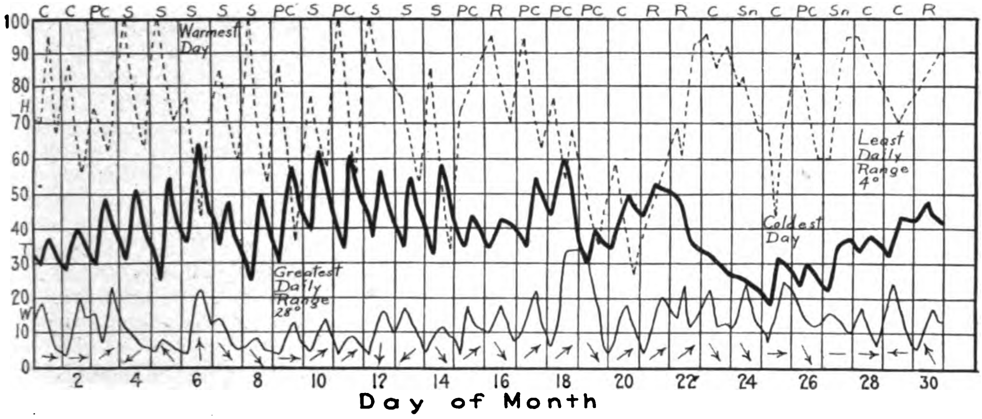


RECORD OF THE WEATHER IN NEW YORK FOR NOVEMBER, 1917.

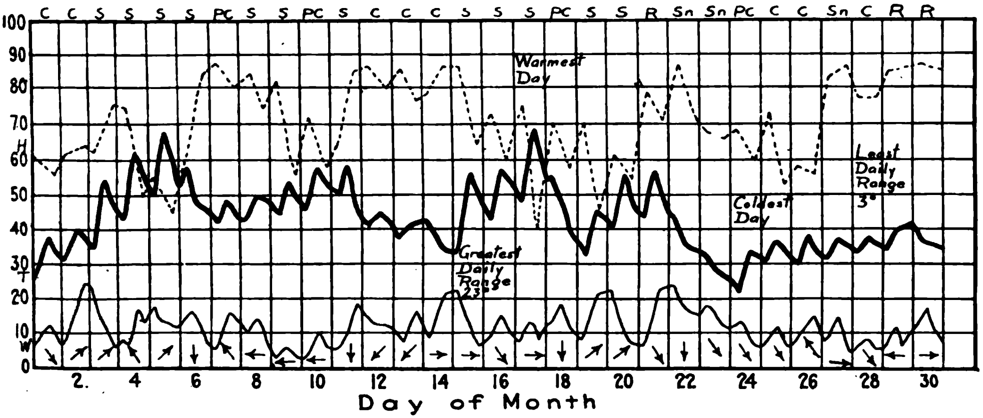
(Hourly observations of the relative humidity are recorded on this chart.)



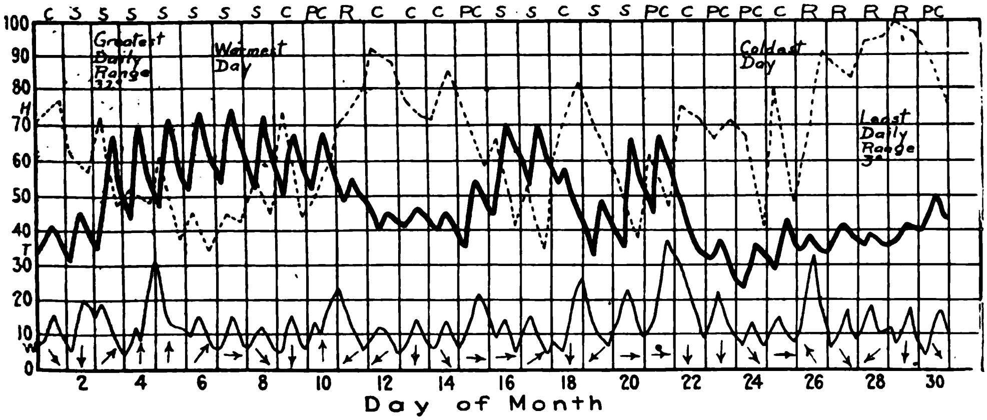
RECORD OF THE WEATHER IN BOSTON FOR NOVEMBER, 1917.



RECORD OF THE WEATHER IN PITTSBURGH FOR NOVEMBER, 1917.
(Relative humidity observations taken at 8 a. m., noon and 8 p. m.)



RECORD OF THE WEATHER IN CHICAGO FOR NOVEMBER, 1917.



RECORD OF THE WEATHER IN ST. LOUIS FOR NOVEMBER, 1917.

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.
Heavy lines indicate temperature in degrees F.
Light lines indicate wind in miles per hour.
Broken lines indicate relative humidity in percentage from readings taken at 8 A. M. and 8 P. M.
S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.
Arrows fly with prevailing direction of wind.

How the Contractors Saved the Day at Camp Upton.

All accounts agree that nothing more strenuous has ever happened in American commercial life than the work of constructing and equipping the great army cantonments within the time limits prescribed by the government. From all sides come tales of almost insuperable difficulties met and overcome, although the exertions necessary to put things through were often nerve-racking in the extreme.

Camp Upton, at Yaphank, L. I., N. Y., was no exception to the rule. The contract for the equipment of this cantonment was in the hands of the Thompson-Starrett Co., of New York. The installation was in direct charge of W. H. Driscoll, head of the heating department of that company. So important was the undertaking that the matter of working hours for those in charge was a thing not to be thought of. The working day consisted of the necessary time to get things done even if it took all the time there was, day and night.

A typical instance of the kinds of problems that were constantly confronting the contractors was told by Mr. Driscoll at a recent meeting of the New York Chapter of the Heating engineers' society. The contractor at Camp Upton had promised the constructing quartermaster that the pumping station would be put in operation on Sunday, September 1, and that water would be pumped into the mains on that date. To fulfill this promise it was necessary to maintain a force of workmen constantly at full efficiency so that absolutely accurate measurements of connecting parts could be determined in advance; that these parts be manufactured, delivered and assembled on schedule time and that there be absolutely no slip in any part of the program.

The problem confronting the contractor may be better understood when it is realized that the manufacture of the various parts would ordinarily consume from three to four months, whereas, the work had to be done in less than three weeks. By almost super-human effort most of the material was manufactured and delivered to the job and assembling of same was well under way by Friday, August 30.

The vacuum pumps, however, had been lost in transit as well as the disconnecting switches which were to be erected on the poles outside the pumping station. Inspectors were working day and night tracing these shipments, while, at the same time, efforts were being made to duplicate the materials required. Telegrams were sent out to the various manufacturers in an effort to secure duplicate apparatus. Representatives were sent to the factories near New York in an effort to beg, or borrow the required materials.

On Saturday morning, August 31, enough material was gotten together in one of the factories to make up the disconnecting switches. These were packed in a box and the contractor's representative had them trucked to the railroad station. The box was about as large as two ordinary trunks and weighed 350 lbs., and could by no stretch of the imagination be considered as baggage. Under the ordinary rules of the road there were only two ways to ship it; one was by express and the other by freight, but shipment either way meant that the goods could not possibly have been delivered before Monday or Tuesday.

The only way to get the material to the job on time was to persuade the railroad agent that the material in the box was personal baggage and entitled to transportation as such. The agent called attention to the fact that if it were personal baggage, the box would have handles on it, but this little difficulty was remedied by the contractor's representative who purchased a piece of rope and nailed rope handles on either end.

After much persuasion, at about the time the train for New York was pulling in, the agent accepted the material but in attempting to have it put on the baggage car, it was turned down again.

Another argument ensued but the box was finally accepted and started for New York under the watchful eye of the contractor's representative. By telegraphing ahead, arrangements were made so that when the train pulled into New York at six o'clock, Saturday, an auto truck was backed up to the railroad station and the box promptly transferred to same. The chauffeur was instructed to break all the speed records to Yaphank, which he did, and at eleven o'clock at night be delivered the goods to the pumping station. The electricians by working all night on the poles had the connecting switches erected in place by Sunday morning.

The vacuum pumps, however, had not arrived on the job nor had it been possible to locate duplicate pumps and unless a vacuum could be created in the suction line to draw the water out of the wells, and properly prime the pumps, all previous effort would have been wasted—insofar as the fulfillment of the promise was concerned. Fortunately, however, there arrived at the camp that day a small air compressor which was intended to be used in connection with the fire whistle. This compressor was picked up in the camp and rushed by auto truck to the pumping station. Here the suction side of the compressor was hooked up to the vacuum chamber and, although it imposed a load on the little compressor that it was never intended to carry, it responded nobly and, after much effort, succeeded in creating sufficient vacuum to raise the water from the wells and prime the pumps and at 1:30 o'clock the pumps were put in operation and the water turned into the mains in accordance with previous promise.

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A Heating, Plumbing and Tinning Cost Book.

A cost book that takes in all the important items for heating, plumbing and tinning work, has recently been published by Richards & Roberts, Stamford, Conn., under the title of the R & R Plumbing, Heating and Tinning Cost Book. The book is made up of a series of tables, all thumb-indexed with red leather tags, the whole making a very presentable and convenient volume. The materials listed are brass bibs, brass fittings (rough and finished), brass gate valves, brass pipe, cast-iron fittings, covering, drainage fittings, expansion tanks and range boilers, galvanized fittings, galvanized iron, gate and check valves, lead traps and bends, leaders and gutters, pipe, pipe hangers, radiator valves, boilers (round and square), soil pipe soil fittings and price sheet.

The book is prefaced with an interesting table for determining a single net discount for any group of discounts. There is also at the back a price sheet for entering the current prices of all the materials listed.

Considerable ingenuity has been shown in the preparation of the tables which are simply arranged so as to be clear at a moment's glance. The data should be very useful to all who are engaged in this line of work.

The cost book sells for $13.00 bound in leather and for $10.00 bound in cloth. The leather covers are limp, so that the book may be readily folded. Size 9½ x 11¼ in., with 37 tables.

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New Publications.

Proceedings of the National District Heating Association for 1917, have been published by Secretary D. L. Gaskill, Greenville, O., in a volume containing 371 pages. A complete transcript is given of the papers and reports presented at the association's meeting in Detroit, June 12-15, together with the discussions. The volume also contains the new officers and committees, a revised membership list, the revised constitution and by-laws. In connection with the report of the heating research committee, the entire data compiled by a joint committee of the N.E.L. and the N.D.H.A. on actual steam operating costs in various industrial buildings, are given in full. The figures include the principal items in the operation of some 32 office buildings, plants and store.

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Current Heating and Ventilating Literature.

Under this heading is published each month an index to the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the article mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

HOT-WATER HEATING

Hot-Water Heating Under Forced Circulation. Charles D. Allan. Ills. 1,200 w. Power—Oct. 9, 1917. Serial, 1st part. First of six articles. Present article explains the elemental mechanical principles of hot-water heating.

SKATING RINKS

Ice Skating Rinks. M. R. Carpenter, with discussion. Ills. 16 pp. A. S. R. E., Jl.—Sept., 1917. Summary of essential points to be considered.

VENTILATION

Factors in the Ventilation of Schools, Assembly Halls and Business Buildings. George E. Reed. 2,500 w. Ore Soc. Engrs., Jl.—Sept., 1917. Discusses artificial ventilation, air washers, air filters, etc.

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Death of J. O'Meara.

It has not been generally known in the trade that J. O'Meara, of New York, inventor of the O'Meara valve, extension spindle for valves, and many other devices, died some time ago of diabetes, at his home in Brooklyn. One of Mr. O'Meara's most successful inventions was a vulcanized rubber disc and white metal disc. He was for many years engineer at the Union Club, New York, and later organized the O'Meara Valve Co., of Arlington, N. J. He had a wide circle of friends in the New York trade.

New Form of Ductometer.

An interesting form of ductometer, for use in proportioning duct systems, has been developed by George P. Bender, C. E., New York, and is shown half-size in the accompanying illustration. It consists of two discs, one superimposed on the other and pivoted in the center. The lower disc, which is opaque, has on it an outer scale representing the quantity of air per minute to be delivered and is used to find the dimensions of the duct for area. A scale marked "Friction in inches of water per 100 ft. of duct," represents the loss of head due to friction. A scale marked "Quantity, cu. ft. A.P.M.—for friction" represents the relation between the quantity air per minute and the frictional size of the duct, and is used to find the pressure-loss when the duct size is known. There is also an inner scale on which the radial lines represent the smaller size of the duct, the circular lines the larger size of the duct, and the radial curves the increase in area of a rectangular duct of equivalent friction as compared with a square duct. The curves represent the length of the side of a square duct, the diameter of a circular duct of equivalent frictional resistance as compared with a square duct, and the diameter of a circular duct of equivalent area as compared with a square duct, respectively.

The upper disc is transparent and has on it an outer scale which represents the velocity in feet per minute; the indicators, A, B, C and D, which represent the constants for frictional losses in ducts of smooth metal, smooth plaster or concrete, rough plaster or concrete, and brick, respectively, for air at 70° F.; an inner scale which represents both the larger size of a rectangular duct, and the length of a square duct; and an indicator curve.

FORMULA USED IN DESIGNING DUCTOMETER.

The design of the ductometer is based upon the well-known formula:

$$H = 4\frac{kLv^2}{2gD} \quad \dots\dots\dots\dots (1)$$

in which,

H = head in feet causing flow
k = constant
L = length in feet
g = acceleration due to gravity
v = velocity in feet per second
D = diameter of duct in feet

also.

$$H = f\frac{w}{12a} \quad \dots\dots\dots\dots (2)$$

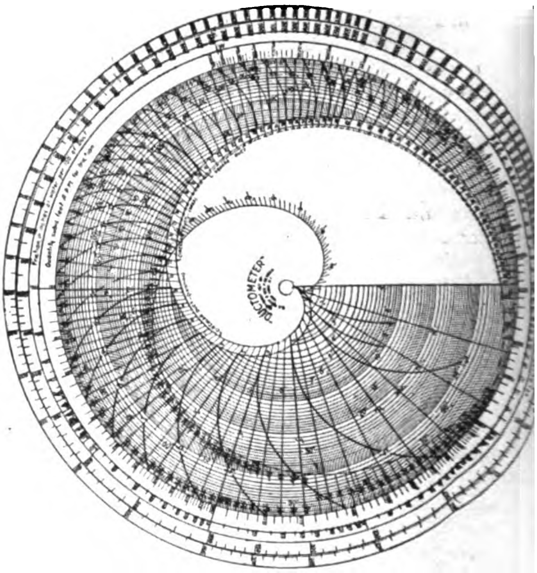
where,

f = head, expressed in inches of water
W = density of water
A = weight of air in lbs per cu. ft.

In practice, however, it is convenient to express the quantity in cubic feet A.P.M., the velocity in feet per minute, and the duct-sizes in inches. Therefore, we have,

$$\text{where } f = \frac{851.93\,AkLQ^2}{2g\pi^2 d^5} \quad \dots\dots\dots\dots (3)$$

f = friction loss expressed in in. of water
A = weight of air in lbs. per cu. ft.
L = length of duct in feet
Q = quantity cu. ft. A.P.M.
g = acceleration due to gravity
d = diameter of duct in inches.



NEW FORM OF DUCTOMETER FOR PROPORTIONING DUCT SYSTEMS. (Half Size.)

But, as we are dealing with square and rectangular ducts, as well as circular ones, the equation, in a more convenient form, becomes,

$$\frac{2gf}{26.62AkLQ^2} = \frac{32}{\pi^2 d^5} \quad \dots\dots\dots\dots (4)$$

and,

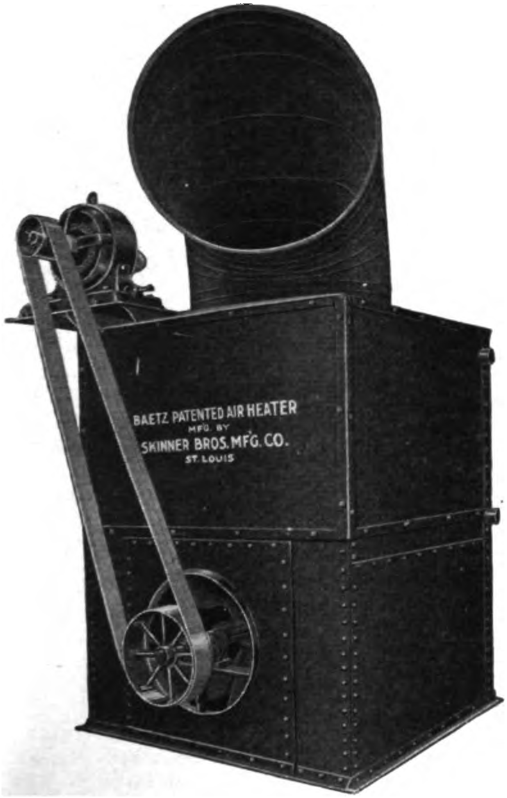


FIG. 1.—BAETZ PORTABLE BLOWER HEATER UNIT.

$$\frac{32}{\pi^2 d^5} = \frac{2}{z^5} = \frac{x + y}{x^3 y^3} \qquad \text{..............} (5)$$

where,

x = the longer side of the duct
y = the shorter side of the duct
z = the length of the side of a square duct

Equations 4 and 5 give the sizes of square and rectangular ducts, having the same frictional resistance per unit of length as a round duct, with the same quantity of air per minute.

The ductometer is also adapted for finding the flow of water and loss of head in pipes. For ventilating work it has a range of sizes from 1 in. × 1 in. to 120 in × 120 in., with equivalent round and rectangular ducts, for both area and friction. Quantities from 100 to 1,000,000 cu. ft. of air per minute, and frictions from 0.0001 in. to 100 in. water gauge per 100 ft. of duct.

In a booklet entitled, "The Ductomer and Its Use," published by R. D. Ward and George P. Bender, C. E., 120 Broadway, New York, several typical examples are given to show the operation of the ductometer, accompanied by rules for the use of the ductometer in seven different cases. Directions are also given for applying the ductometer to problems in the flow of water in pipes.

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A Portable Blower Heating System.

Some remarkable features of compactness and adaptability are to be noticed in a new type of portable blower system of heating which has been placed on the market by Skinner Bros. Mfg. Co., St. Louis, Mo., under the name of the Baetz air heating apparatus. These units, it is stated, are in successful operation in many of the largest foundries and industrial plants in the United States and they are especially recommended for heating large exposed buildings. Other uses of the Baetz heating system are in connection with the removal of steam and vapor in large packing houses and paper mills. In many cases they are used for both heating and vapor removal. They also serve for drying purposes in the manufacture of such products as fire-brick, candy, shoes, etc.

The Baetz heater is constructed of steel plates and angles. The upper part is occupied by coils of steam pipe, arranged so that they may be readily removed for repairs. A blower or fan is placed beneath them in the same enclosure. Air is drawn

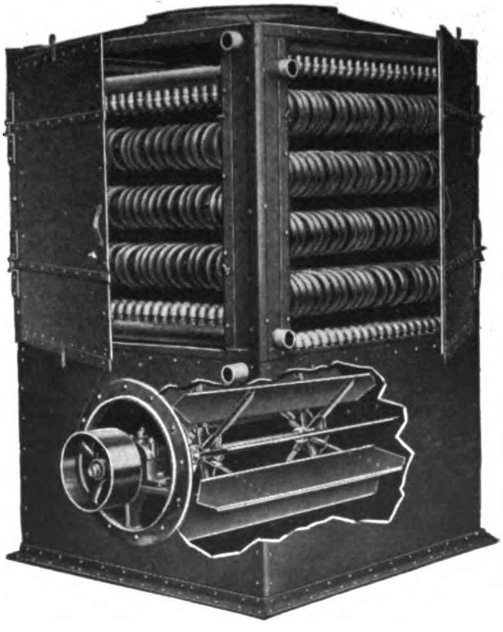


FIG 2.—CONSTRUCTION OF COILS IN BAETZ HEATER.

in by the fan from two sides and is forced upward against the steam-heated coils, passing out at the top as heated air. It will be noticed that the fan does not handle the heated air, thus increasing its capacity.

A conventient line shaft, a small engine or motor may be used to propel the fan. The heater is provided with a suitable shelf at the top upon which a motor can be placed.

To make ready to place in operation all that is required is to connect live or exhaust steam to the pipe shown at the upper right-hand corner of Fig. 1. The other pipe just below is the drain and is to be conected to the return line to the boiler.

Fig. 2 shows the construction of the coils, the methods of connecting the coils to the heater, the positive system of draining the coils and the ease with which they may be removed. It also shows the construction and location of the fan directly under the heating coils.

The manufacturers point out that when a small steam engine is used for driving the fan the exhaust steam from the engine can be piped direct into the heater coils.

◆

Trade Literature.

WESTINGHOUSE DIRECT-CURRENT MOTORS AND GENERATORS are the subject of the second of a series of catalogues of industrial motors which has just been distributed by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. This is known as Catalogue 30 and embraces the company's complete line of direct-current motors and generators for industrial service. The new catalogue is identical in size and will fit the binder for the company's line of catalogues covering supply apparatus and small motors. Size 8¼x10¾ in. Pp. 80, with index.

NATIONAL ROTARY OIL BURNERS for use in house-heating boilers, hot water heaters or warm-air furnaces, are illustrated and described in a circular received from the National Rotary Oil Burner Co., Boston, Mass. These burners may be installed by removing the two center grates and slipping the burner in the ashpit door, letting the base of the burner rest in the ashpit. The oil tank can be placed outside the basement and underground, if desired. A small motor is used to operate the burner and produce combustion, which drives a spray plate and fan. Directions are given in the circular for operating the burner and emphasis is laid on the economy of this arrangement, compared with the use of coal. Automatic control is obtained by the use of a regulator furnished by the company. Comments of satisfied users are included in the bulletin.

BRAEMER HUMIDIFIERS AND DEHUMIDIFIERS, for humidifying, cooling, dehumidifying, and for low-temperature drying work, are featured in newly-issued circular matter received from the Braemer Air Conditioning Corporation, Philadelphia, Pa. A list of some of the more noteworthy installations is given, with the announcement that the company is prepared to design air conditioning apparatus for industrial processes of every description. Other circulars issued by the company are devoted to the Webster "Type A" air washer for securing moderate cooling effects, as in public buildings, and the Webster "Type B" air washer, for securing the greatest cooling effect possible by evaporation.

ABRAMS GAS FURNACE, designed especially for use with natural gas in heating buildings, is called to the attention of the trade through a new catalogue devoted to this apparatus, which is manufactured by the Abrams-Orton Mfg. Co., Wadsworth, O. The Abrams burners, which are an interesting feature of this furnace, are placed lengthwise of the firebox and through the casing, so that they may be removed without extra trouble. Being a sawed burner, it serves to eliminate the noise, and the placing of the burners in the manner described serves to distribute the fire the full length of the firebox. The air for combustion is taken from three tubes that connect the firebox to the bottom of the casing. The fire-box is raised 12 in. from the bottom of the casing to allow the fresh air to travel around fire-box. These tubes act as a cellar ventilator as well as for its purpose of supplying air for the gas. This air, as it reaches the firebox, is conducted to the burners by a baffling plate which allows it to pass on either side of the burner and come in contact with the blaze. The heated fumes from the fire-box travel to the radiators that are bolted to top part of fire-box, spaced three inches apart. These radiators are bolted and packed with asbestos. They are 2½ x 21 x 36 in. high, having 1728 sq. in. of radiating surface each. From the radiators the fumes travel through a tube which, being small, retains part of the heat in the radiator, traveling through these tubes to a vent manifold around the dividing plate to the chimney connection. The furnace is lighted with a pilot light on the outside of cast plate. Size 5 x 7 in. Pp. 16.

COMPUTING RADIATION.

In computing the amount of radiation, the kind of radiator surface to be used, its method of installation whether direct, recessed, concealed or indirect, the work it must do and its position in the room—all bear upon the matter. Care must be taken to distinguish between *actual* radiator surface and *equivalent* direct radiator surface (E. D. R.). Actual radiator surface is the actual exposed radiating surface expressed in square feet but E. D. R. depends entirely on its efficiency. Equivalent direct radiation (E. D. R.) is most easily defined as being ¼ lb. of steam (or 250 B. T. U.) per hour, this being the approximate condensation of 1 sq. ft. of actual cast-iron radiator surface under ordinary operating conditions.

Thus, if an indirect radiator of 10 sq. ft. actual surface is giving off heat at the rate of 400 B. T. U. per square foot per hour (or has an *efficiency* of 400 B. T. U.) its total B. T. U. delivered will be 10 × 400 = 4000, but its E D. R. will be 4000/250, or 16 sq. ft. In figuring boiler capacity, pipe sizes, and all other calculations relating to the heat delivered, steam required or condensation to be handled, the E. D. R. should be used as a basis of calculation.

Having found the B. T. U. required to heat a given room by use of the factors and formulae previously given on Data Sheets Nos. 1-7 calculation of the required radiating surface is usually made by dividing the total B. T. U. to be supplied by 250, which is the assumed efficiency of all radiation per square foot. While it is true all radiation does not give this efficiency (for exact results of tests on different styles of radiators see Standard Data Sheet No. 13-A) it is much easier to use the 250 divisor and then to add a percentage than to use a multitude of different divisors.

The only variation from this should be for indirect heaters which, for gravity work, are usually considered as having an efficiency of 400 or 500 B. T. U., and for pipe coils, which are usually considered as having an efficiency of 300 B. T. U., unless on the ceiling where the undesirable position causes such a reduction of efficiency that 250 B. T. U. is again correct.

Radiators installed so that the air does not circulate freely around them suffer a loss of efficiency and must be increased as follows:

Cast-iron radiators on ceiling	10%
Recessed radiators	20%
Concealed	40%
Radiators near doors	100%

The increase of radiators near doors is to have extra surface to counteract drafts when the doors are opened and to care for the larger leakage loss encountered in such locations.

EFFICIENCY OF RADIATING SURFACE

The efficiency of radiating surface varies in different types of radiators although not to such an extent as to make any great difference in the amount of surface used. The co-efficients of efficiency are computed by multiplying the condensation (in pounds per sq. ft. per hour) by the latent heat of the steam at its pressure and dividing by the temperature difference between the room and the steam in the radiator. Otherwise the co-efficient may be said to be the number of B. T. U. transmitted per square foot of heating surface per hour per degree difference.

Tests made by Professor R. Allen at the University of Michigan show those co-efficients to be as follows and column 4 is computed from column 3 on the basis of 5 lbs. of steam pressure and 150 degrees temperature difference.

Type of Radiating Surface.	No. of Pounds Condensed per Sq. Ft. per hr.	Co-efficient of Transmission B.T.U. per deg.	Efficiency of Surface B.T.U. per Sq. Ft. Per hr.
CAST-IRON			
1-column	0.212	1.82	273
2-column	0.265	1.65	248
3-column	0.204	1.45	218
6-column	0.217	1.35	202
5 sq. ft. wall (vertical)	—	1.92	288
5 sq. ft. wall (horizontal)	—	2.11	317
7 sq. ft. wall (vertical	—	1.70	255
7 sq. ft. wall (horizontal)	—	1.92	288
9 sq. ft. wall (vertical)	—	1.77	265
9 sq. ft. wall (horizontal)	—	1.98	297
Bare pipe coils			
1 Pipe high	0.410	2.80	420
4 Pipes high	0.425	2.48	372
PRESSED STEEL			
2-column	—	1.53	222

EXAMPLE OF COMPUTING DIRECT RADIATION

Assume a room with three windows and one door with a computed loss of 20,000 B. T. U. Then the direct radiator surface will be 20,000/250 = 80 sq. ft. for either cast-iron radiators or pipe coils on the ceiling.

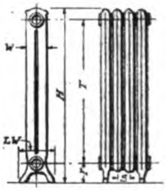
80 + 10% = 88 sq. ft. for cast-iron ceiling radiators.
80 + 20% = 96 sq. ft. for cast-iron recessed radiators.
80 + 40% = 112 sq. ft. for cast-iron concealed radiators.

If ordinary exposed radiators are used they may be divided into four radiators of 20 sq. ft. each—which, however, is rather too small for practical use. Probably three would be used, two of 27 sq. ft. and one—near the door—of 54 sq. ft.

For pipe coils along the walls near the floor the surface would be 20,000/300 = 67 sq. ft.

AMERICAN RADIATOR COMPANY'S ROCOCO ONE-COLUMN RADIATORS FOR STEAM AND WATER

No. of Sections	*Length 2½ in. per Sec.	Heating Surface — Square Feet: 38-in. Height 3 sq. ft. per Sec.	32-in. Height 2½ sq. ft. per Sec.	26-in. Height 2 sq. ft. per Sec.	23-in. Height 1⅔ sq. ft. per Sec.	20-in. Height 1½ sq. ft. per Sec.
2	5	6	5	4	3⅓	3
3	7½	9	7½	6	5	4½
4	10	12	10	8	6⅔	6
5	12½	15	12½	10	8⅓	7½
6	15	18	15	12	10	9
7	17½	21	17½	14	11⅔	10½
8	20	24	20	16	13⅓	12
9	22½	27	22½	18	15	13½
10	25	30	25	20	16⅔	15
11	27½	33	27½	22	18⅓	16½
12	30	36	30	24	20	18
13	32½	39	32½	26	21⅔	19½
14	35	42	35	28	23⅓	21
15	37½	45	37½	30	25	22½
16	40	48	40	32	26⅔	24
17	42½	51	42½	34	28⅓	25½
18	45	54	45	36	30	27
19	47½	57	47½	38	31⅔	28½
20	50	60	50	40	33⅓	30
21	52½	63	52½	42	35	31½
22	55	66	55	44	36⅔	33
23	57½	69	57½	46	38⅓	34½
24	60	72	60	48	40	36
25	62½	75	62½	50	41⅔	37½
26	65	78	65	52	43⅓	39
27	67½	81	67½	54	45	40½
28	70	84	70	56	46⅔	42
29	72½	87	72½	58	48⅓	43½
30	75	90	75	60	50	45
31	77½	93	77½	62	51⅔	46½
32	80	96	80	64	53⅓	48



Connections: WATER—Extra-heavy right and left-hand nipples at top and bottom. STEAM—right threaded, extra-heavy nipples at bottom only.

* Add ½ in. to length for each bushing.

Low-Drip Hubs: ONE PIPE STEAM—on supply leg section; TWO-PIPE STEAM on return leg section.

DIMENSIONS

H = Total overall height.
T = C. to C. of tappings on water radiators.
F = Floor to center of bottom tapping.
W = Width of radiator—4 13/32 in.
LW = Width of radiator legs—5⅜ in.
S = Width of radiator sections; *i.e.*, c. to c. of sections, or 2½ in.

Nominal Height of Radiator	38-in.	32-in.	26-in.	23-in.	20-in.
H	37 5/8	31 47/64	26	23 3/32	20 11/64
T	31 3/32	25 13/64	19 15/32	16 9/16	13 41/64

Note: For legless radiators deduct 3-in. from H.
For high legs add 2-in. and for extra high 4-in. to H and F.

TAPPING DATA

All radiators are tapped 2-in. and bushed as follows:

SYSTEM	Size of Radiator, Square Feet	Supply In. Diam.	F In.	Return In. Diam.	F In.
Steam, one-pipe	Up to 24, inc.	1	4	..	..
	24 to 60, inc.	1¼	4	..	..
	60 to 100, inc.	1½	4	..	..
	Over 100	2	4	..	..
Steam, two-pipe	Up to 48, inc.	1	4½	¾	4
	48 to 96, inc.	1¼	4½	1	4
	Over 96	1½	4½	1¼	4
Water	Up to 40, inc.	1	4	1	4
	40 to 72, inc.	1¼	4	1¼	4
	Over 72	1½	4	1½	4

Air valve tappings are ⅛ in.
Vapor tappings, top and bottom, opposite ends, ¾ in. supply and ½ in. return.
All tappings with right-hand threads unless otherwise ordered.

THE HEATING AND VENTILATING MAGAZINE

Cooperstown, N. Y. FEBRUARY 1918 1123 Broadway, New York

Problems in Locating Radiation Below Boiler Level

One of the most troublesome problems encountered in gravity steam heating is to meet conditions where radiation must be placed below the water-line of the boiler. In forced hot-water systems, this can be done without difficulty; in gravity hot-water systems it may be carried out to a reasonable extent; in vacuum steam systems no trouble is experienced, but in gravity work the situation is entirely different.

As the name implies, a *gravity* system depends upon the force of gravity to return the water of condensation to the boiler—the pressure on each side of the return being the same (or as nearly the same as possible) and the water returning to the boiler due to its own weight.

In a gravity heating job there are some radical features of design which can be altered sometimes so as to avoid the bad condition of having the radiation come below the water-line; for instance, (*a*) the radiation may be slightly increased and located on the ceiling so as to bring it sufficiently high, or (*b*) the boiler may be depressed and set in a pit so as to bring its water-line low enough to allow the radiation in question to be drained, or (*c*) a combination of (*a*) and (*b*) may be used, or (*d*) the system may be changed to a vacuum system, or (*e*) steam may be generated at high pressure and the condensation returned by traps or receiver pumps.

While any of the above may be used to *avoid* such conditions the purpose of this article is to discuss what can be done when, for certain reasons, the system *must* be kept a gravity system, when the boiler *cannot* be depressed and when high-pressure steam is *not* desirable.

A TYPICAL CASE, WITH ONE OR TWO RADIATORS BELOW WATER LINE.

Suppose a small, low-pressure gravity system with the requirements of one or two radiators below the water-line of the boiler and in a building of such character that any mechanical device is not desirable—how can this be arranged?

Since automatic devices are not to be considered, about the only solution is to make the radiator in the shape of a cooling coil, and running the hot water of condensation through it. In order to have the radiator satisfactorily perform its function, the condensation should flow through the sections to the full capacity of the radiator tappings so as to supply the radiator properly with hot water and in order to keep up a proper circulation. On the other hand, the quantity of condensation returning is a variable factor depending upon the quantity of radiation in use in the building.

For this reason the piping for the radiator should be so arranged as to cause the condensation to flow through the radiator by preference up to the capacity of the radiator tappings and, (when this capacity is exceeded) the surplus condensation should by-pass the radiator, returning directly through the return line without circulating through the radiator. At times, when the radiator may be shut off, *all* the condensation should automatically by-pass the radiator so as not to interfere with the proper operation of the gravity system.

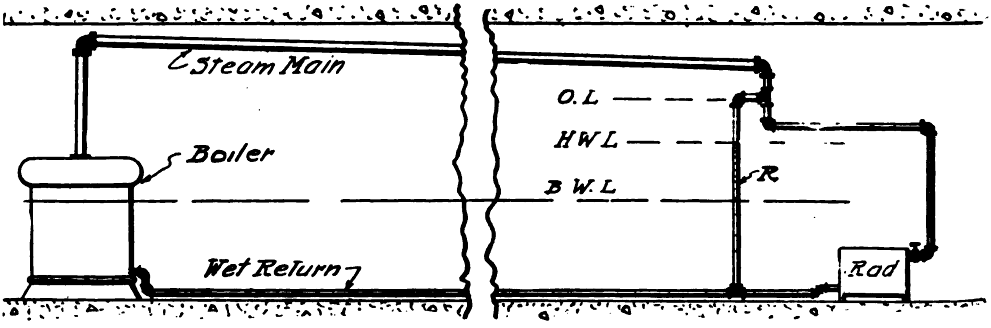


FIG. 1—METHOD OF RETURNING CONDENSATION FROM RADIATOR BELOW WATER LINE WITHOUT USE OF MECHANICAL DEVICE.

All this can be done with very simple pipe connections arranged as shown in Fig. 1, in which the condensation drops down the pipe leading to the supply connection to the radiator. The boiler water-line (B.W.L.) is high enough to keep the radiator flooded at all times and at the end of the system (where the radiator in question is assumed to be installed) the loss in steam pressure has backed up the return so as to produce a high waterline (H.W.L.). Whenever the condensation in flowing down to the radiator exceeds the capacity of the radiator pipe connections, or the radiator is shut off at the valve, it backs up in the radiator supply pipe until its level reaches the overflow line (O. L.) the excess, or even the entire flow, then spilling over into the return pipe (R), thus leaving the operation of the gravity system uninterrupted. The branches from the steam main for the regular gravity system are not shown in Fig. 1, these being assumed as located in the broken-out portion. Of course, the radiators would be figured the same as a *hot water heating* job, would be of the hot water type with top and bottom connections, and without automatic air valves.

A CASE REQUIRING THE USE OF A TRAP.

The next case to be considered is where an operating device is not absolutely prohibited, but the amount of radiation to be taken care of is so small as to make the installation of any power-consuming apparatus out of the question. Under such a condition the use of a trap might be suggested somewhat along the lines shown in Fig. 2.

Here a steam radiator with automatic air valve is used, the radiator being computed for size the same as any *steam* radiator and having its return carried up to a direct-return trap setting on top of the boiler. The elevation of the trap must be a little above the boiler water-line, as will be seen when the operation of the apparatus is considered; (usually about 4 ft. above the water line is sufficient).

The return trap is provided with a steam connection direct from the steam main near the boiler, so that whenever the trap becomes full of water it operates, closing off the return pipe from the radiator and opening both the steam pipe from the main and the discharge pipe to the boiler return; the vent connection is carried to a closed pet-cock discharging into the air. This results in equalizing the pressure both on the top and below the water in the trap, so that it naturally sinks down the return pipe and into the boiler through the return connection.

As soon as the trap is relieved of its water it automatically shuts off the steam pipe and discharge line to boiler and opens the return line from the radiator. But what raises the radiator return from the radiator level into the trap?

At the time the trap starts to operate, its capacity is entirely filled with steam and water; as it empties and the water descends into the boiler steam rushes in and occupies the space which the water leaves. Thus, when the trap has completed its operation the condition exists of a trap full of steam, and every pipe closed off, except the one from the radiator return. This steam, through radiation losses, almost immediately starts to condense, forming a partial vacuum within the trap and this partial vacuum becomes stronger and stronger as the condensing continues until it literally sucks up the condensation from the lower level of the radiator, the condensation entering the trap and occupying the space left by the condensing steam.

CASES WHERE RECEIVERS ARE USED.

In larger installations, where there are quite a number of radiators to be handled in this manner a receiver is sometimes used at point "X", in which the condensation collects during the time the trap is operating. To start the apparatus all that is necessary is to open the closed pet-cock on the trap vent until steam blows through, showing that the trap is full of steam —which is necessary in order to condense and form the required vacuum. The shutting off of the pet-cock will

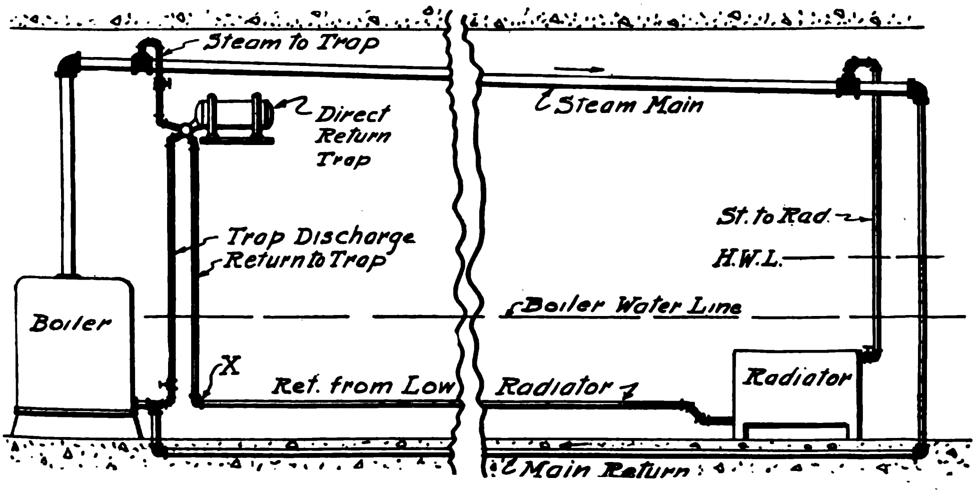


FIG. 2—CASE REQUIRING USE OF A TRAP.

leave the trap full of steam the condensing of which begins the cycle of operation.

Some traps do not automatically shut off the lines and open them again at the proper time, such traps operate the steam supply line only and depend on check valves to do the rest. In such cases a check is placed on the radiator return where it enters the trap and another check on the trap discharge where it leaves the trap. Then, when steam is admitted to the trap, the return check closes and the discharge check opens, permitting the discharge to enter the boiler return line and, when the steam is cut off, the return check opens, permitting the return to enter, but the discharge check is closed so that none of the discharge water is sucked back.

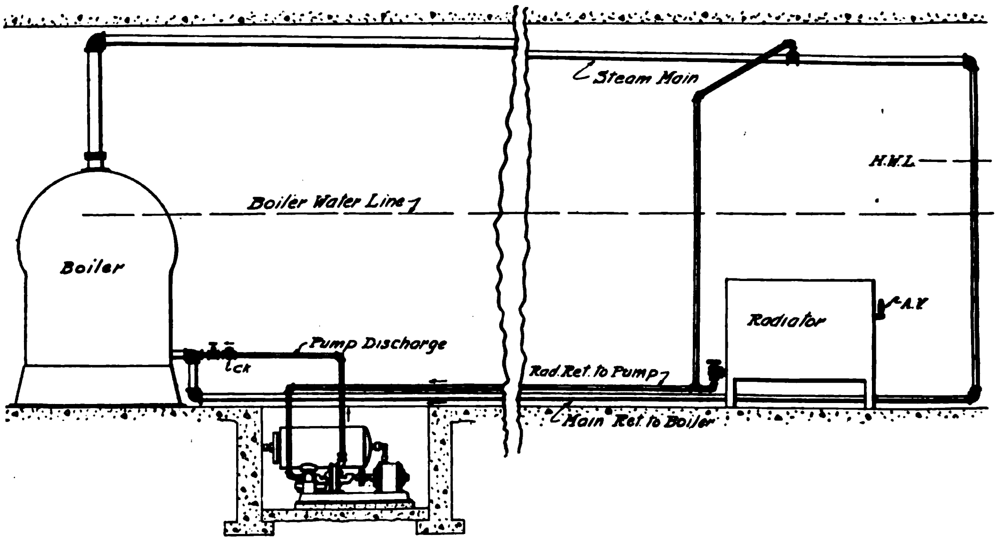


FIG. 3—ARRANGEMENT OF AUTOMATIC RETURN PUMP AND RECEIVER FOR DRAINING LOW RADIATION.

AN AUTOMATIC RETURN PUMP AND RECEIVER SOMETIMES NECESSARY.

When such low radiation increases to a considerable amount the best solution is contained in a small electric-driven automatic return pump and receiver. Where this is used the pump is set low enough to drain all the low radiation into the receiver by gravity. When the receiver is filled with water to a certain level the tilting of the receiver or the action of a float control throws the electric switch and starts the motor which drives the pump.

In Fig. 3 is shown a typical case of this kind with the gravity return going back to the boiler as usual and the low radiator return connected to the pump receiver, set below the radiator level. The pump discharges the return through a check and stop valve into the regular return line, being connected as close to the boiler as possible.

These receiver pumps are also made steam-operated so that where a high-pressure plant is installed, a steam pump can be used at no operating cost at all, the exhaust being turned into the heating system and there utilized. The electric outfits are made in graduated capacities, running from 1000 to 1500 sq. ft. of radiating surface up to 25,000 sq. ft., or larger.

CHICAGO COMMISSION ON VENTILATION

Ventilation Test in an Old Building

The Dante Grammar School, Chicago, Ill.

EDITED BY SAMUEL R. LEWIS

This is the second of a series of reports covering recent work done by the Chicago Commission on Ventilation. These reports will appear exclusively in the columns of THE HEATING AND VENTILATING MAGAZINE, *except that the commission will have reprints available, following publication. The previous report described the test in the Lewis Champlin School, Chicago, and appeared in the December,* 1917, *and January,* 1918 *issues.*

The foregoing test of the heating and ventilating system in the Lewis Champlin School * covered a new plant, in a new building, in a comparatively wealthy neighborhood. For purposes of comparison, the commission carried on tests, at about the same time, of the Dante School, having a similar equipment, but in an old building, built in 1902 and in an addition, built in 1908, in the Ghetto district of Chicago.

In the Lewis Champlin school the pupils come clean and well dressed. In the Dante school compulsory bathing facilities are necessary.

In the Lewis Champlin school the air-ways and ducts were new and presumably free from dust. In the Dante school presumably the dust accumulations of years are present.

The Dante school is located in the east half of the block bounded by Desplaines, Gilpin, Halsted and Forquer Streets. The original building is 229 ft. by 88 ft.; the addition is 145 ft. by 115 ft. There is a basement, three stories and a shallow attic under a flat roof. The building accommodates under an average of 35 pupils to a room, a total of 1,300 pupils. The heating and ventilating plant is located in the basement.

Attention is called to the general introduction and the detailed description of the heating and ventilating system in the Lewis Champlin school, which so nearly fits conditions at the Dante school that it is unnecessary to repeat it here. Fresh air is taken from the roof level through two shafts, one for the addition, and one for the old building and the assembly hall. Humidity is introduced into the air by means of steam jets, but at the Dante school these are hand-controlled instead of having automatic devices, as at the Lewis Champlin school.

MECHANICAL EQUIPMENT.

The mechanical equipment of the Dante school in general is as follows:

Boiler Plant—300 H.P., horizontal tubular boilers, hand-fired; working pressure around 60 lbs.

Supply Fans—3 units as follows:

1. Old building, one standard steel-plate, centrifugal housed blower; wheel 9 ft. in diameter, direct-connected to a 9½ x 12 in. steam engine.

2. New Building, one standard steel-plate, centrifugal housed blower; wheel 8 ft. in diameter, direct-connected to a 9½ x 12 in. steam engine.

3. Assembly Hall, one standard steel-plate centrifugal housed blower; wheel

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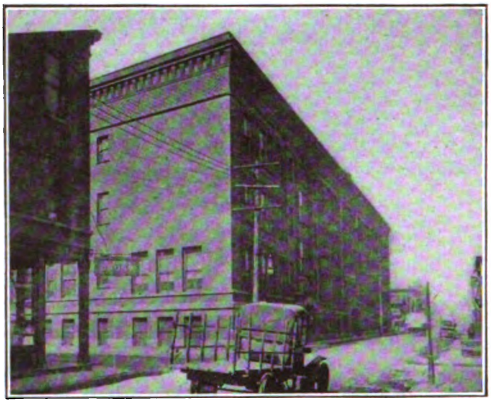
*Published in THE HEATING AND VENTILATING MAGAZINE for December, 1917 and January, 1918.



FRONT VIEW OF DANTE SCHOOL.

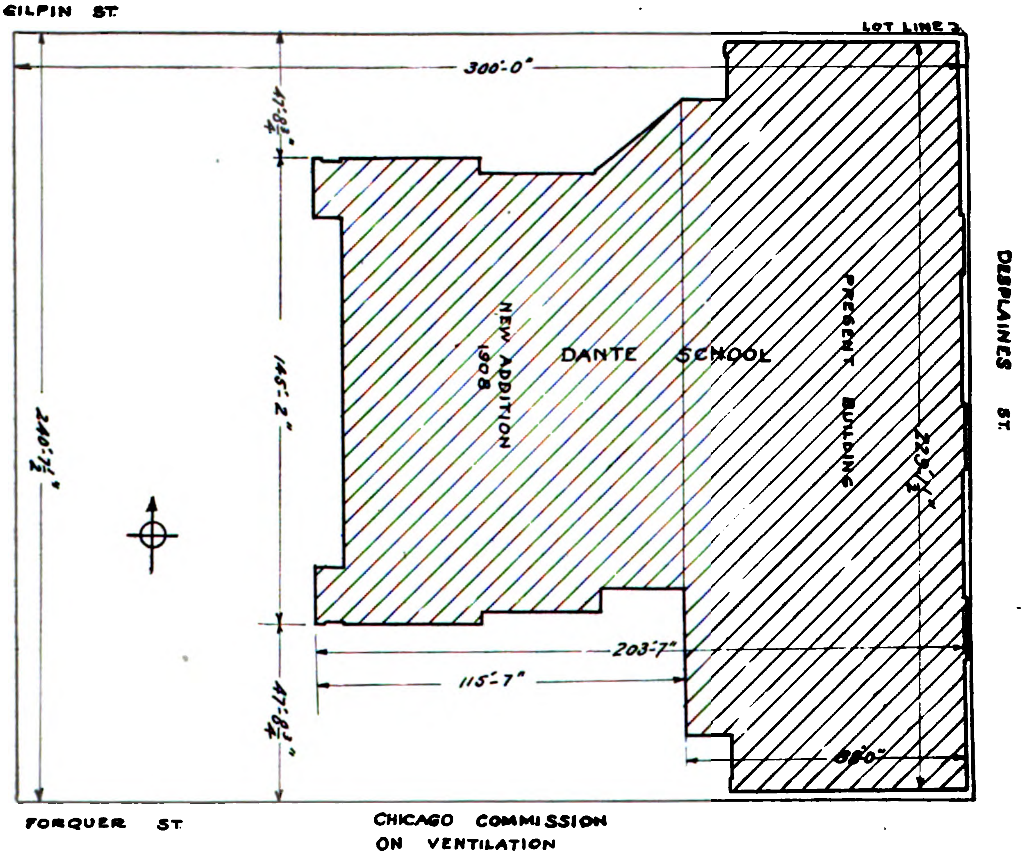
5 ft. 6 in. in diameter, direct-connected to a 7 x 10 in. steam engine.

Heaters:

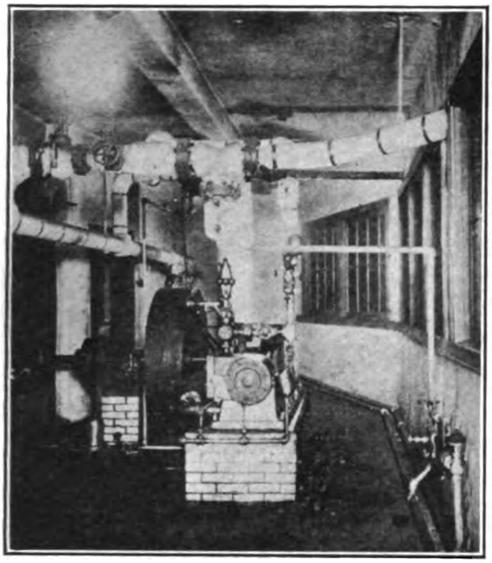
1. Old Building—the tempering and re-heating coils being of 1-in. pipe in cast-iron bases, are placed at each of the two discharge openings from the fan. In the two groups which supply two plenum chambers, there are 5200 sq. ft. of surface.

2. New Building—the arrangement is similar to that in the old building. Total radiation, 3372 sq. ft.

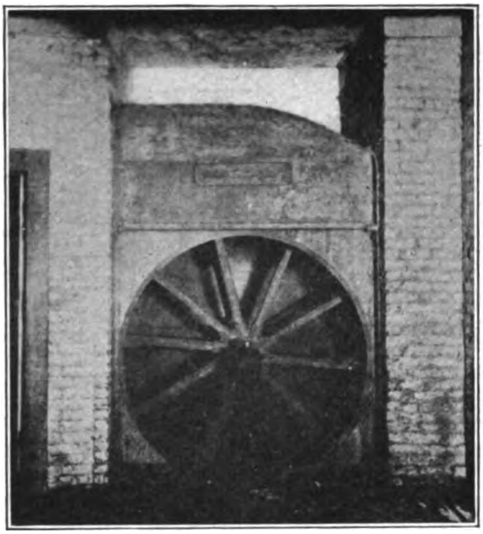
REAR VIEW OF DANTE SCHOOL.



PLAT PLAN OF DANTE SCHOOL.



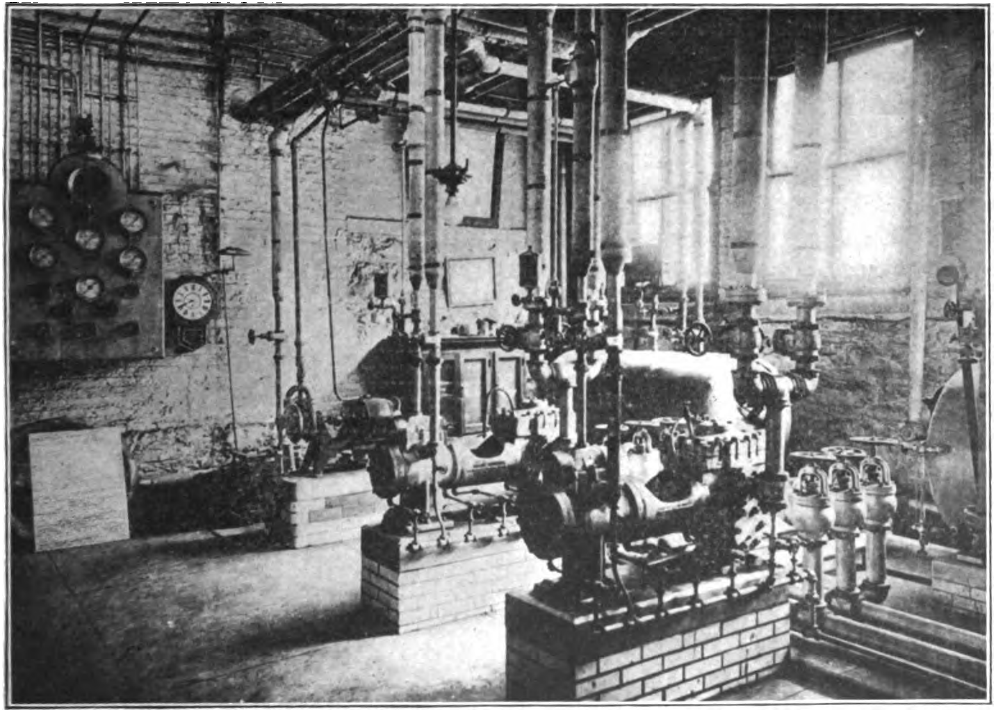
ENGINE DIRECT-CONNECTED TO FAN.



FAN, FROM INTAKE SIDE.

3. Assembly Hall—there is a single group of heaters at the fan outlet; total radiation, 980 sq. ft.

Since the testing of the Dante School was done by the same persons who tested the Lewis Champlin School, the technique had been established, and we are able fairly to present an average as well as individual tests. The various conditions ob-



TANK AND ENGINE ROOM, DANTE SCHOOL.

served will be discussed under the same general classification as for the Lewis Champlin school. Test sheets are shown covering observations in the kindergarten, and in rooms 105, 109, 202, 205, 209, 304, 306 and 311.

Dante Kindergarten
Feb. 15, 1917.

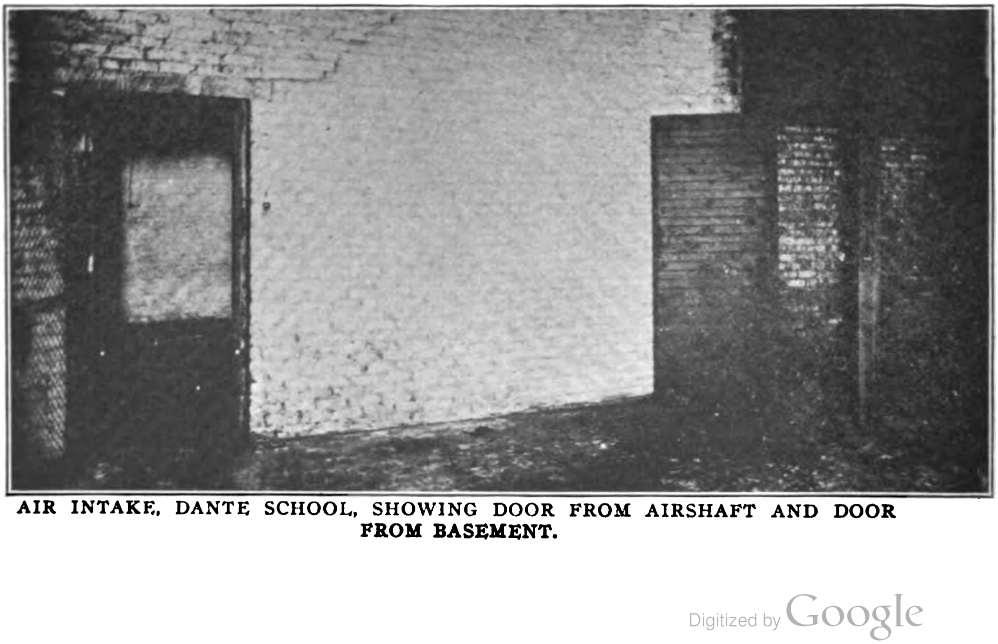
This may fairly be compared to the test of room 209 of the Lewis Champlin school, of March 9, as both rooms were at the southeast corner, with a southwest wind.

	Cubic Feet Air space per Pupil	C.F.M. per Pupil	Ave. Temp. Deg.F.		Av. Rel. Humidity Per Cent.	Av. Dust	Av. Bacteria	Av. CO_2	Excess of CO_2 over outside
			Dry	Wet					
Dante Kindergarten	370	48	74	55	27	20600	18	9.3	5.4
Lewis Champlin 209	290	30	70	52	27	51000	5.2	6.4	2.2

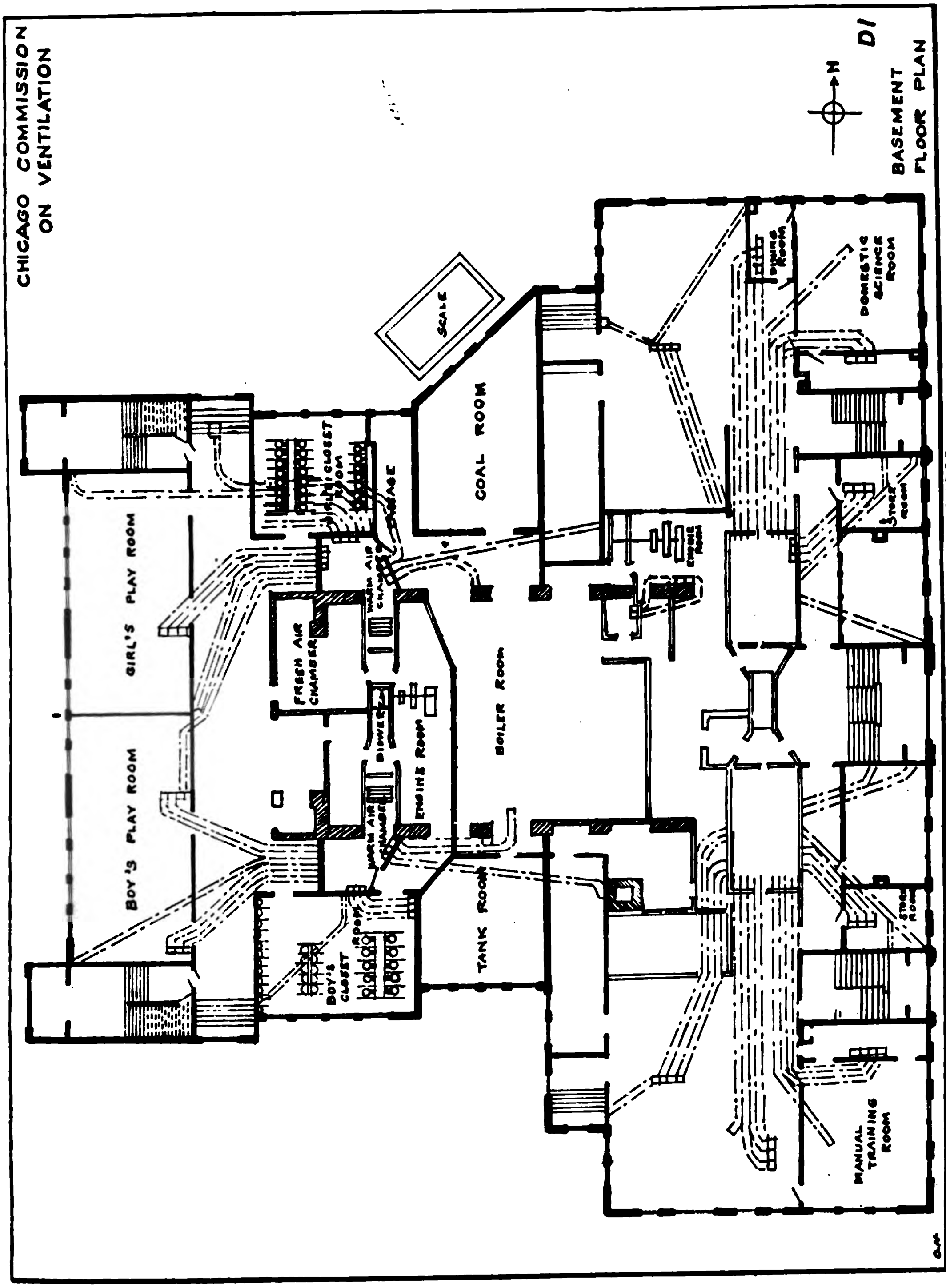
KINDERGARTEN DANTE SCHOOL.

In both rooms the leakage was outward; in the Dante about 23% of the air introduced leaked out elsewhere than at the exhaust. At the Lewis Champlin this percentage was about 25%. It will be noted that the pupils at the Dante were receiving in excess of 50% more air per minute than at the Lewis Champlin. In both rooms the location of supply and exhaust openings was similar. The Dante supply opening, however, is 96x7¾ in. while at the Lewis Champlin it is 72x19 in., giving a much lower inlet velocity. The CO_2 outside at the Lewis Champlin, was 4.2 parts, compared to 3.4 parts at the Dante.

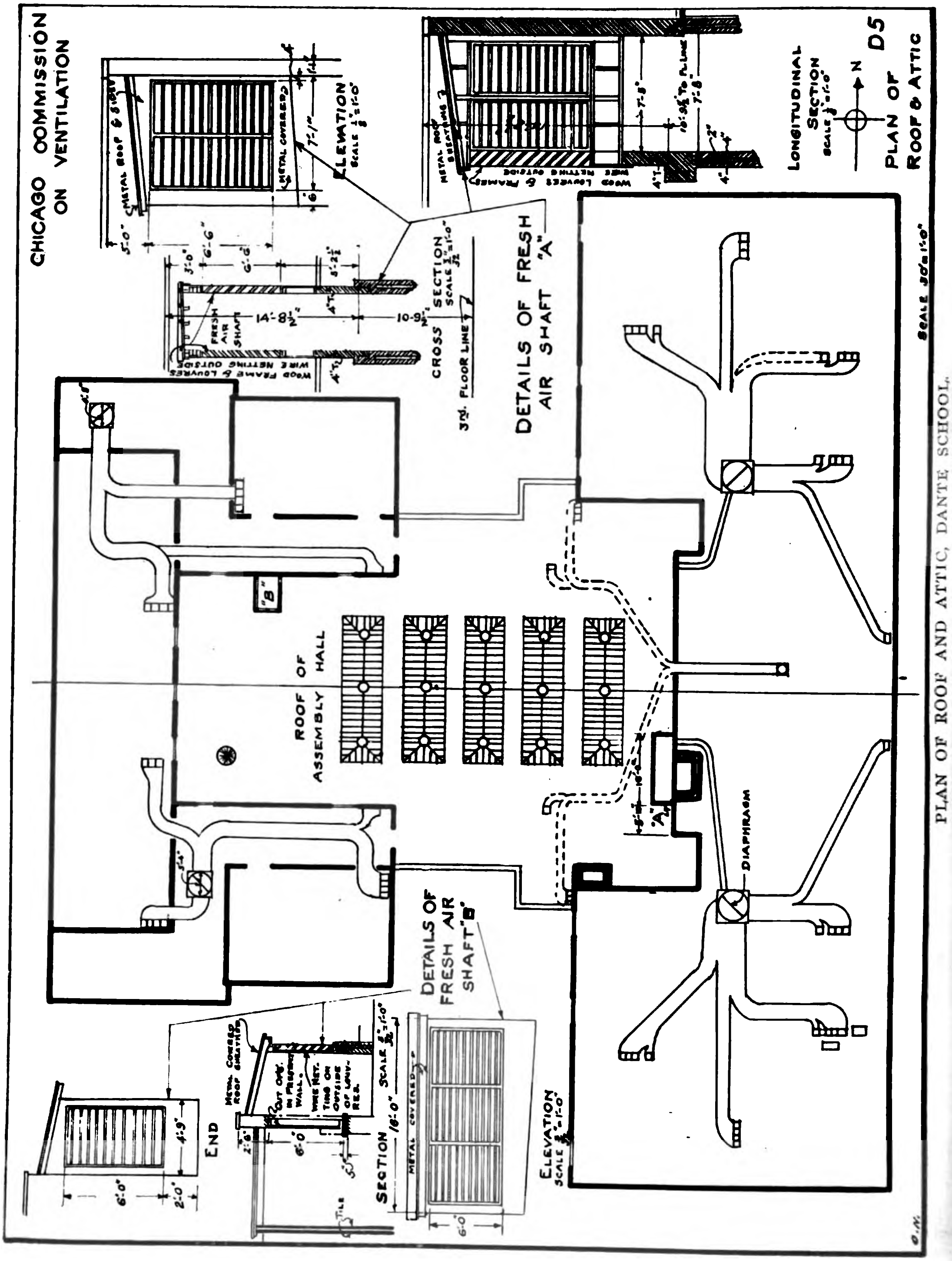
In the Dante school the exhaust is at the floor, drawing off the contaminated air near an interior wall, while at the Lewis Champlin it is at the floor, drawing off the contaminated air nearer to an exterior wall. In the Dante the supply is at the center of an interior wall, discharging toward the glass at the south, at a velocity high enough to create an injector



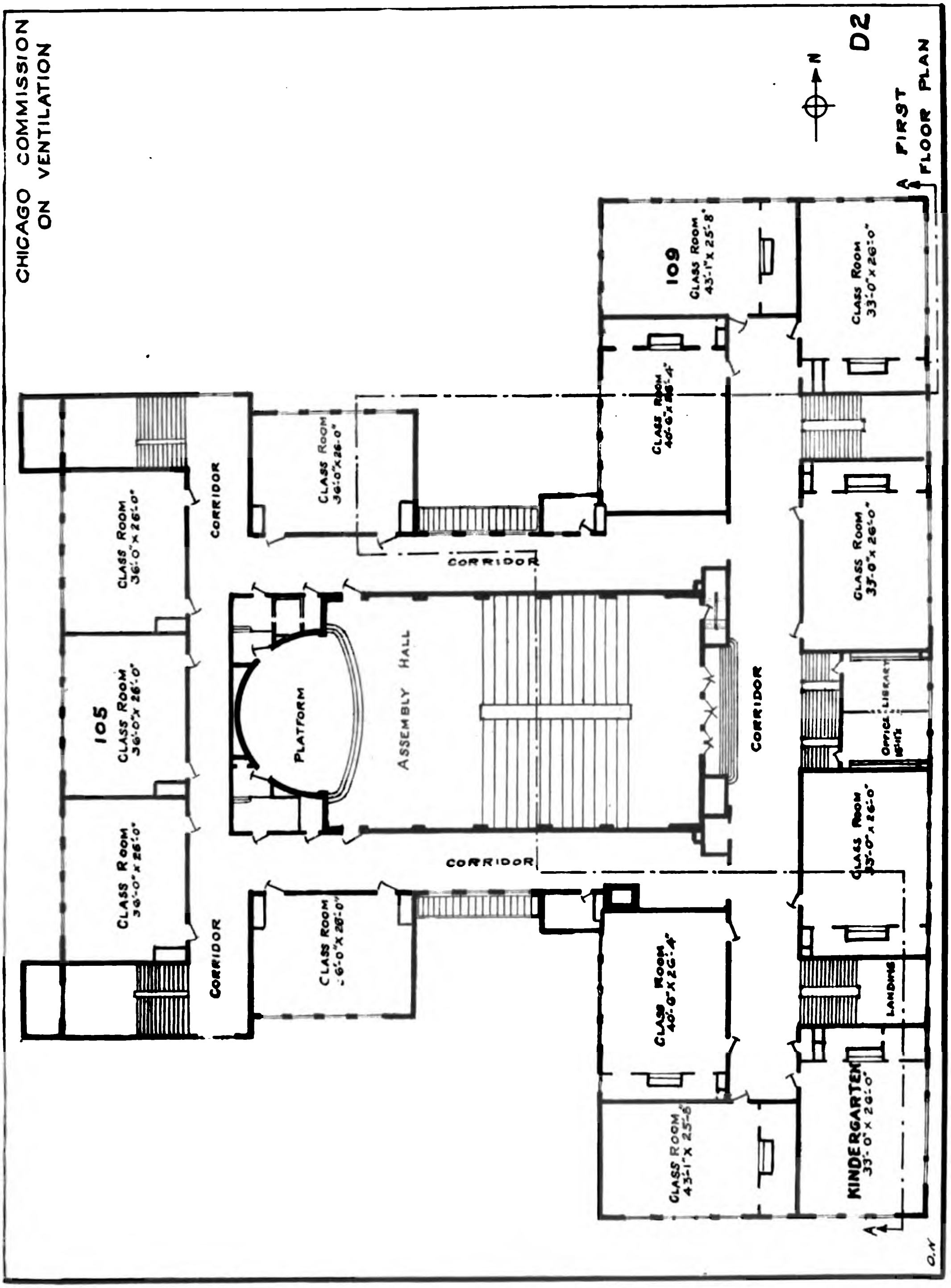
AIR INTAKE, DANTE SCHOOL, SHOWING DOOR FROM AIRSHAFT AND DOOR FROM BASEMENT.



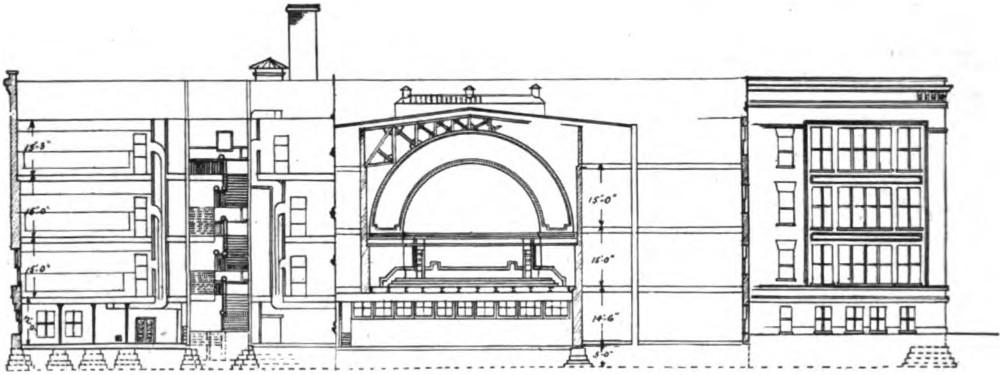
BASEMENT FLOOR PLAN, DANTE SCHOOL.



PLAN OF ROOF AND ATTIC, DANTE SCHOOL.


CHICAGO COMMISSION
ON VENTILATION
D2
N
FIRST FLOOR PLAN
A
109
CLASS ROOM 43'-1" x 25'-8"
CLASS ROOM 33'-0" x 26'-0"
CLASS ROOM 40'-0" x 26'-4"
CLASS ROOM 36'-0" x 26'-0"
CORRIDOR
CLASS ROOM 36'-0" x 26'-0"
105
CLASS ROOM 36'-0" x 26'-0"
CLASS ROOM 36'-0" x 26'-0"
CORRIDOR
PLATFORM
ASSEMBLY HALL
CORRIDOR
CLASS ROOM 33'-0" x 26'-0"
LIBRARY
OFFICE
CORRIDOR
CLASS ROOM 33'-0" x 26'-0"
CORRIDOR
CLASS ROOM 26'-0" x 26'-0"
CLASS ROOM 40'-0" x 26'-4"
LANDING
CLASS ROOM 43'-1" x 25'-8"
KINDERGARTEN 33'-0" x 26'-0"
A
CORRIDOR
O.N

FIRST FLOOR PLAN, DANTE SCHOOL.

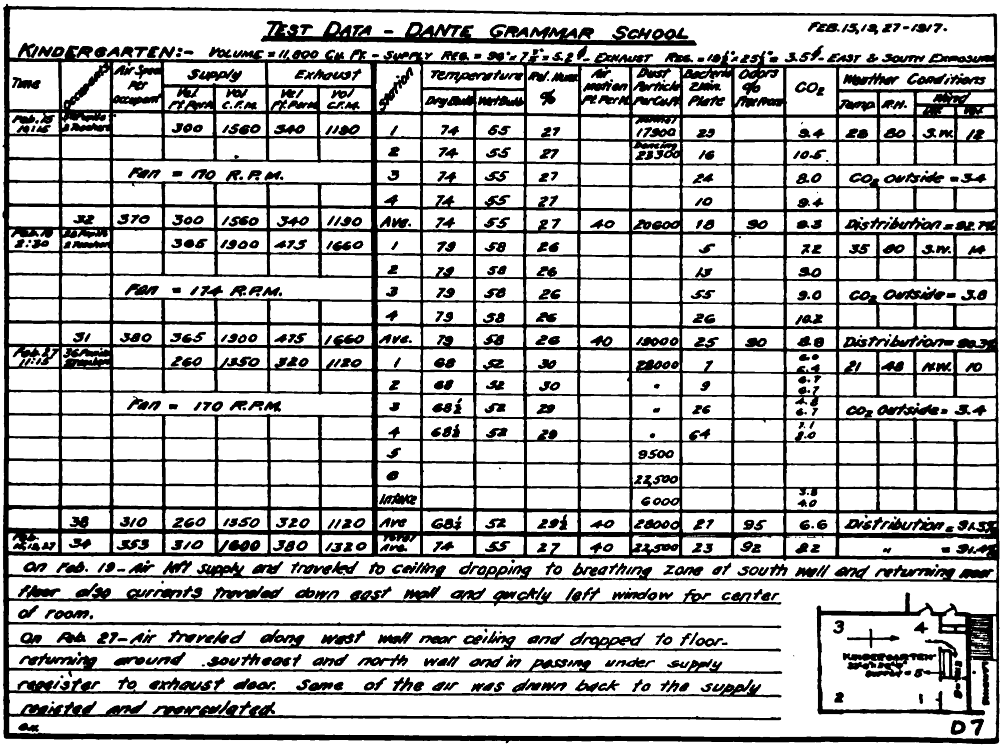


SECTION "AA"

CROSS-SECTION OF DANTE SCHOOL.
(See First-Floor Plan.)

effect, causing a recirculation of contaminated air along with the jet of fresh air. In the Lewis Champlin, the supply is close to an interior wall, discharging toward a cold exterior wall, at low velocity. The injector effect was not noted here.

In the Dante part of the fresh air seems to have been thoroughly mixed with the contaminated air, and to have kept a large part of the same in constant circulation, as evidenced by the high CO_2 observation. In the Lewis Champlin, however, the fresh air



TEST DATA - DANTE GRAMMAR SCHOOL FEB. 15, 19, 27 - 1917.

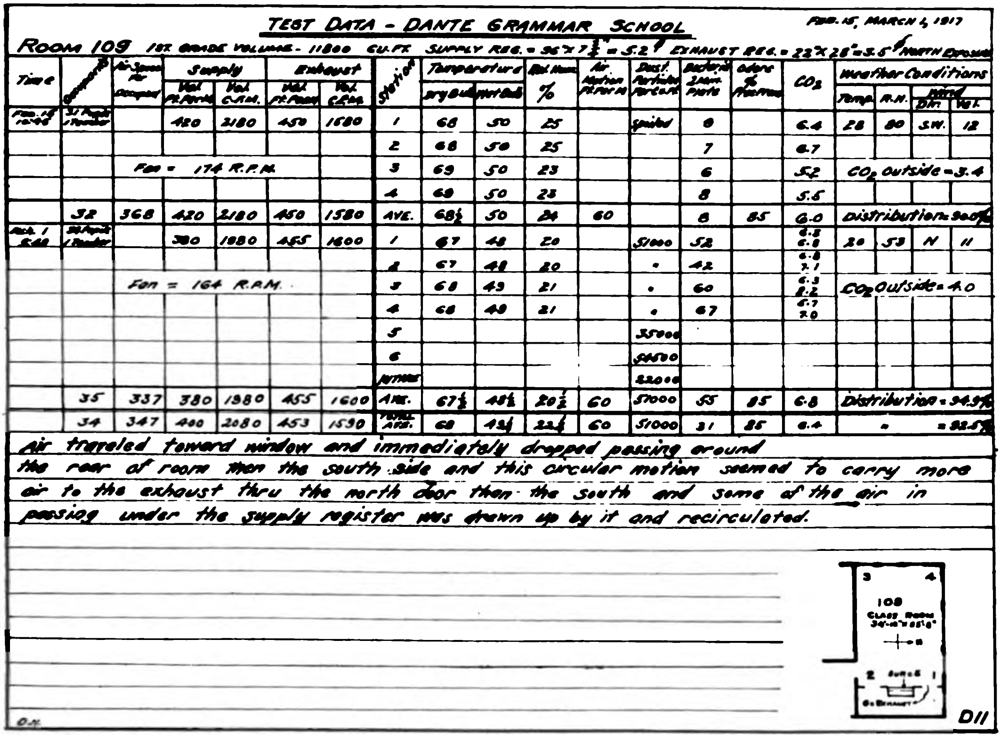
KINDERGARTEN:- VOLUME = 11,800 CU. FT. - SUPPLY REG. = 96"x 7½" = 5.2 □' - EXHAUST REG. = 18½"x 25½" = 3.5 □' - EAST & SOUTH EXPOSURE

Time	Occupants	Air Space Per Occupant	Supply		Exhaust		Station	Temperature		Rel. Hum.	Air motion	Dust Particles	Bacteria 2 Min.	Odors %	CO_2	Weather Conditions			
			Vel Ft. Per M.	Vol C.F.M.	Vel Ft. Per M.	Vol C.F.M.		Dry Bulb	Wet Bulb	%	Ft. Per M.	Per Cu. Ft.	Plate	Positive		Temp.	R.H.	Wind Dir.	Wind Vel.
Feb. 15 10:15	30 Pupils 2 Teachers		300	1560	340	1190	1	74	65	27		[illegible] 17900	23		9.4	28	80	S.W.	12
							2	74	55	27		Dancing 23300	16		10.5				
		Fan = 170 R.P.M.					3	74	55	27			24		8.0	CO_2 outside = 3.4			
							4	74	55	27			10		9.4				
	32	370	300	1560	340	1190	Ave.	74	55	27	40	20600	18	90	9.3	Distribution = 92.7%			
Feb. 19 2:30	29 Pupils 2 Teachers		365	1900	475	1660	1	79	58	26			5		7.2	35	60	S.W.	14
							2	79	58	26			13		9.0				
		Fan = 174 R.P.M.					3	79	58	26			55		9.0	CO_2 Outside = 3.8			
							4	79	58	26			26		10.2				
	31	380	365	1900	475	1660	Ave.	79	58	26	40	19000	25	90	8.8	Distribution = 90.3%			
Feb. 27 11:15	36 Pupils 2 Teachers		260	1350	320	1120	1	68	52	30		28000	7		6.0 6.4	21	48	N.W.	10
							2	68	52	30		"	9		6.7 6.7				
		Fan = 170 R.P.M.					3	68½	52	29		"	26		4.8 6.7	CO_2 Outside = 3.4			
							4	68½	52	29		"	64		7.1 8.0				
							5					9500							
							6					22,500							
							Intake					6000			3.8 4.0				
	38	310	260	1350	320	1120	Ave	68½	52	29½	40	28000	21	95	6.6	Distribution = 91.5%			
Feb. 15, 19, 27	34	353	310	1600	380	1320	Total Ave.	74	55	27	40	22,500	23	92	8.2	" = 91.4%			

On Feb. 19 - Air left supply and traveled to ceiling dropping to breathing zone at south wall and returning near floor also currents traveled down east wall and quickly left window for center of room.

On Feb. 27 - Air traveled along west wall near ceiling and dropped to floor - returning around southeast and north wall and in passing under supply register to exhaust door. Some of the air was drawn back to the supply register and recirculated.

TEST DATA FOR KINDERGARTEN.



TEST DATA - DANTE GRAMMAR SCHOOL FEB. 15, MARCH 1, 1917

ROOM 109 1ST GRADE VOLUME - 11800 CU. FT. SUPPLY REG. = 36"×7½" = 5.2′ EXHAUST REG. = 22"×28" = 3.5′ NORTH EXPOSURE

Time	Occupants	Air Space Per Occupant	Supply Vel. Ft. Per Min.	Supply Vol. C.F.M.	Exhaust Vel. Ft. Per Min.	Exhaust Vol. C.F.M.	Station	Temperature Dry Bulb	Temperature Wet Bulb	Rel. Hum. %	Air Motion Ft. Per M.	Dust Particles Per Cu. Ft.	Bacteria 2 Min. Plate	Odors % Absence	CO2	Weather Conditions Temp.	R.H.	Wind Dir.	Wind Vel.
Feb. 15 10.45	31 Pupils 1 Teacher		420	2180	450	1580	1	68	50	25		spoiled	8		6.4	28	80	S.W.	12
							2	68	50	25			7		6.7				
		Fan = 174 R.P.M.					3	69	50	23			6		5.2	CO2 outside = 3.4			
							4	69	50	23			8		5.6				
	32	368	420	2180	450	1580	AVE.	68½	50	24	60		8	85	6.0	Distribution = 90.0%			
Mch. 1 9.40	34 Pupils 1 Teacher		380	1980	455	1600	1	67	48	20		51000	52		6.5 6.8	20	53	N	11
							2	67	48	20		"	42		6.8 7.1				
		Fan = 164 R.P.M.					3	68	49	21		"	60		6.3 8.2	CO2 Outside = 4.0			
							4	68	49	21		"	67		6.7 7.0				
							5					35000							
							6					94500							
							Outside					22000							
	35	337	380	1980	455	1600	AVE.	67½	48½	20½	60	51000	55	85	6.8	Distribution = 94.9%			
	34	347	400	2080	453	1590	TOTAL AVE.	68	49¼	22¼	60	51000	31	85	6.4	" = 92.5%			

Air traveled toward window and immediately dropped passing around the rear of room then the south side and this circular motion seemed to carry more air to the exhaust thru the north door than the south and some of the air in passing under the supply register was drawn up by it and recirculated.

TEST DATA FOR ROOM 109.

passed around the warmer sides, dropping to the floor as cooled by the exposure, and passing off in a general effect such as to produce ventilation by displacement, as evidenced by the consistent CO_2 observation. In both the temperature and humidity were improperly balanced; both should have been kept cooler as to dry bulb, and higher as to moisture.

Nothing in any of the observations at the Dante as to dust indicated any particular increase in dust attributable to the older ventilating plant. The higher bacteria count at the Dante is perhaps due to the condition of clothing and bodies of the pupils, or may be due to the fact that the Lewis Champlin school had been fumigated the previous afternoon. Comparing however, with other Lewis Champlin rooms, 209 was unusually low in bacteria, and the other rooms tested were more consistent with the Dante, despite their recent fumigation.

It will be noted that the three tests of the Dante kindergarten show undue variation in the volume of air delivered at the same fan speed; undue variation in temperature, and consistently too low relative humidity. The air distribution improved, as per CO_2 indication, on Feb. 27, when the wind was from the northwest. The dust increased materially that day with a lower outside relative humidity. These latter observations, it will be noted, were made when the air supply per minute per pupil was reduced to about 35 cu. ft., instead of 48 cu. ft., as on Feb. 15.

Dante 109 is similar in plan to the kindergarten and the same remarks apply to it. Some local condition for which we cannot account must have been responsible for the remarkably high dust and bacteria observations of March 1.

In next month's issue the results will be given of tests in Rooms 209, 105, 304, 202, 205, 306 *and* 311, *together with the conclusions of the commission.*

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Important Actions Taken at Society's Annual Meeting, in New York, January 22-24, 1918

Actions of unusual importance were taken at the twenty-fourth annual meeting of The American Society of Heating and Ventilating Engineers, which was held at the Engineering Societies Building, New York, January 22-24. After many years of effort the final draft of a code for testing low-pressure heating boilers was accepted by the society and will be promulgated as the society's standard code for this purpose in the future.

Another action which, in its possibilities, outranks anything the socity has ever done, was the decision to establish a research laboratory where tests can be made of all kinds of heating apparatus and devices, as well as of methods, the results, when finally accepted by the society, to be put forward as standard practice. The details of the plan are given on another page in the report of the research bureau committee.

FREDERICK R. STILL
President, American Society of Heating and Ventilating Engineers.

The matter of a warm-air furnace code was taken up and the society voted to go ahead with the preparation of such a code, both for testing and for methods of installation.

War had its effect on the attendance, but the well-arranged program held the close attention of the goodly number present. The total registration was 108 members and 59 guests.

Tuesday Afternoon Session, January 22

The opening session convened Tuesday afternoon with President J. I. Lyle in the chair. After appointing the tellers, consisting of H. M. Hart, F. T. Chapman and A. E. Stacey, President Lyle addressed the meeting. His remarks were principally a review of the society's progress during the past year, with special reference to the work being done for the government. The committee on battleship and submarine ventilation has already submitted many suggestions for simplifying this equipment and as a result some of the submarine designs will be revolutionized. He then referred to the committee that had been appointed to serve with the National Defense Council. These appointments, he said had not yet been confirmed by the Defense Council.

Efforts to arrange for closer co-operation with the National District Heating Association, he said, had resulted in the appointment of committees from each organization to bring this about. A joint meeting was planned, with separate business sessions, but at present time it is not certain that the National District Heating Association will hold a convention next summer. If it does the joint meeting will be arranged for some time in June.

President Lyle spoke of the record made in the number of new members added to the rolls during the past year. The total came to 139 which means a net increase of 74 for the year. The financial position of the society, he said, was better than ever before.

The report of the council contained, among other things, a proposed amendment that members over 70 years of age who had been 15 years in business, should be made life members without the payment of any additional dues. This proposal was later adopted. The council reported that there were 38 stars on the society's service flag. The members were also informed that the society was now in possession of the library of the late Alfred E. Kenrick and that these volumes and papers were now a part of the society's library.

Secretary C. W. Obert reported total receipts for the year of $11,809.47 and disbursements of $11,098.28, leaving a balance of $711.19. This, with the balance on hand at the beginning of the year of $4,004.92, brings the present balance to $4,716.11. The society's total assets at the present time are over $15,000 while its total liabilities are $1,155.00, leaving a membership equity per member of $14.63. The amount of outstanding dues is $2,048.00.

Secretary Obert reported that there were 821 members now on the rolls.

Under committee reports that of the committee on schoolhouse standardization was put over to a later session, but it was voted to continue the committee.

Report of Committee on Research Bureau

Perry West reported for the Committee on Research Bureau, George W. Barr, the chairman, having been called into active military service. This committee reported at the last summer meeting of the society. No definite disposition was made of the matter at that time and the committee was asked to continue and report later. The report continues:

1.There is no question in the minds of your committee that the heating and ventilating industry is greatly in need of specific determination bearing upon the co-ordination and standardization of the practices of this art and that the Society of Heating and Ventilating Engineers is the proper organization, not only to perform some of this work, but to assume the direction and encouragement of such of this work as should properly be done by others.

2. The society itself is in need of some fundamental common cause upon which the energies and interests of its members can be centered, and which would increase the vigor and health of the society and place it in the position which it should occupy among the affairs of men.

3. There is no greater work before the heating and ventilating engineers than: 1st—a determination of the standards and practices which will turn to best economic account the various apparatus which are available for use in connection with this work; 2d—the co-operation with, and direction of, manufacturers in the determination of reliable data as to the performance of their apparatus and the further development of this apparatus to best meet requirements, and 3d—the education of the consumer and others with whom we come into business contact along the lines of better co-operation and as to what we are attempting to do.

4. The society should take immediate steps to put the proper forces into operation to accomplish the above results.

Our specific recommendations as to the ways and means of going about this undertaking are as follows:

1. The president of the society should be

authorized to appoint a committee, consisting of the treasurer of the society and two other members (approved by the council), to raise a fund by a popular subscription of not less than $25.00, or more than $100.00 from any one person outside of members and of any amount from members; the same to be paid annually for a period of five years; this fund to aggregate not less than $3,600.00 per year, nor more than $5,000.00 per year; the same to be known as the "Research Laboratory Fund" and to be used as hereinafter specified.

This fund to be collected upon the following basis: That the heating and ventilating engineering profession as well as those associated with or interested in it, can well afford to pay for definite determinations of a standard working basis for all. That the work to be undertaken shall include broad principles, and any such as are applicable to the use of all classes and makes of apparatus without fear or favor for any. That the immediate work of the laboratory shall consist of determinations of the conditions to be met and the best methods of meeting same with available apparatus and only concern itself in the apparatus itself insofar as to cooperate with manufacturers in having them test and develop their own apparatus along lines to best meet these requirements. Contributions to involve no obligation beyond that of the donor to his profession or best interests in the arts of heating and ventilation.

Among examples of some things the laboratory might undertake, are the following: Co-ordination of existing data; standards of heating and ventilating; how fast and to what degree buildings cool down over night and holidays; the rate and load during heating up periods; what is a reasonable amount of attention required by apparatus, etc.

Among examples of some of the things the laboratory might ask manufacturers to furnish are: The rate of evaporation and economy of a boiler at minimum efficiency and at maximum load and the draft and period of firing in each case; the exact surface and transmission factors for radiators and the effect of locations on this, fan performances, engine performances, etc.

2. The council of the society should be authorized to make all arrangements for and to appoint a director for this research work, at a salary of not more than $3,600.00 per year; this director to have charge of and take over all of the work of this undertaking under the direction of the council, provided, however, that no such appointment or arrangements shall be entered into until the above-mentioned fund for same is secured, and an arrangement can be perfected which would be for the best interests of the society. This work to be carried on in conjunction with some university or universities of national repute or the proper governmental departments, or both, as may be decided, for the best interests of the society. Any funds collected in excess of the director's salary and not in excess of $5,000.00 per year, to be used by the president and the council for defraying other expenses incident to this undertaking, or to be allowed to accumulate as a contingency fund for this work as conditions may warrant. Any and all funds subscribed or collected in excess of $5,000.00 per year to be cancelled or returned on a provided basis. All such matters to be within the entire discretion and jurisdiction of the council.

3. The work of this department to be confined to the co-ordination and tabulation of existing data and to such research work as would naturally fall within the province of heating and ventilating engineers to determine, and to the organization and promulgation of a plan whereby manufacturers may be directed and co-operated with in conducting such research and testing work as will produce the required definite data as to the performance of their various apparatus and the proper development of same in connection with the art of heating and ventilating work.

4. This work shall only be undertaken on the condition that some reputable university or governmental department can be arranged with to furnish the necessary accommodations, apparatus and co-operation to satisfy the council that this undertaking may have the necessary co-operation to make it a success.

5. The director of this work should be required to report monthly to the council as to the work and findings of this bureau. Such reports or data therefrom to be edited and published by the council through the publication committee from time to time in the Journal of the society as official conclusions of The American Society of Heating and Ventilating Engineers upon the various subjects handled by the bureau.

After considerable discussion, all of which, however was favorable to the plan proposed, the report of the committee was referred to the council, with the tacit understanding that the plan is to be gotten under way at an early date.

The treasurer's report was presented by Homer Addams, giving in detail the totals presented by the secretary.

James A. Donnelly brought up the need of certain amendments to the charter of the society which were necessary for taxation purposes. These were referred to a later session and then presented in written form and adopted.

CHAPTER REPORTS

Chapter reports presented by the Illinois, Eastern Pennsylvania, Michigan and New York chapters showed all of them to be in a highly satisfactory condition. The Massachusetts Chapter was reported inactive. The petition of the Minneapolis members to form a new chapter to be known as the Minnesota Chapter, was unanimously granted. It is proposed to take in members from the Twin Cities as well as from Duluth and other points.

The work of the Chicago Commission on Ventilation was reviewed for the benefit of the members by J. H. Davis. Mr. Davis said that the commission has completed tests in two factory buildings and in two school buildings. These are being given in full in the columns of THE HEATING AND VENTILATING MAGAZINE. Further tests are being arranged for in the Chicago-Northwestern Building and in the Chicago-Quincy Building. The Normal College testing-room is also to be used in making an elaborate comparative study of open-air and ordinary school ventilation by mechanical means.

The Michigan Chapter reported nearly 100 members. Among the live subjects they are working on are the matters of standardizing vacuum heating specialities as to sizes and capacities and the protection of radiators on sleeping porches from freezing. F. K. Chew, president of the New York Chapter, recommended that the chapters exchange abstracts of their meetings so that they may widen the effect of their papers and discussions.

Tuesday Evening Session, January 22.

THE NEW OFFICERS.

The tellers announced the election of the following officers for 1918:

President, Frederick R. Still, Detroit, Mich.

First Vice-President, Walter S. Timmis, New York.

Second Vice-President, E. Vernon Hill, Chicago, Ill.

Treasurer, Homer Addams, New York.

Members of the Council: William H. Driscoll, New York; Howard H. Fielding, Denver, Colo.; H. P. Gant, Philadelphia; Charles W. Kimball, Boston; J. Irvine Lyle, New York; Frank G. Phegley, Cleveland; Fred W. Powers, Chicago; and Champlain L. Riley, New York.

The Tuesday evening session was devoted to the subject of drying. H. C. Gore, chemist with the Department of Agriculture, opened the session with an account of the recent progress made in the drying of fruits and vegetables, with special reference to the developments since the last summer meeting of the society which he also addressed. Mr. Gore said the small dryer, using only an electric fan without heat, was extensively used in the Middle West last summer and that it was surprising how successfully it had done the work. He exhibited numerous photographs of the various devices used by the department in preparing fruits and vegetables for the drying process and showing the processes in operation. He stated that this work was being done on an extensive scale in Canada and passed around photographs showing an installation where 1,000,000,000 lbs. of food are being dried annually. He stated that the United States Government is keeping in close touch with the department in the drying proposition and that important devolopments were to be expected if it is found necessary to send foodstuffs to the troops abroad for any length of time.

Mr. Gore was asked many questions in a running fire of discussion and was given a vote of thanks at the conclusion of his remarks.

A paper on "High Temperature Drying" was then presented by B. S. Harrison

High-Temperature Drying.

Mr. Harrison's paper was first presented at the December meeting of the New York Chapter, as reported in last month's issue. For the past few years Mr. Harrison has devoted his attention almost exclusively to drying work and his paper was practically a review of the information he had gleaned in that field. The paper covered a wide range including the drying of such products as linseed oil, hay, alfalfa, copra, asphalt japan coatings, and insulation blocks. He spoke particularly of the drying of insulation blocks of asbestos, magnesia and diatomaceous earth in sheets 4 in. thick as taking weeks at low temperatures and with radiant heat and which require days at higher temperatures with direct flame, gas heat. With hot air at high velocity at 600 to 800° F. they dry in 8 hours.

Mr. Harrison gave some interesting points in connection with the design of high-temperature installations. He said so little is known regarding the specific heat, latent heat of evaporation and fusion of many liquids, oils, gums, etc., used in commercial processes, that laboratory experiments are necessary to establish the controlling conditions for commercial installations. Hot dry air sometimes carries static electricity in a drier. This can often be overcome by putting a small steam spray into the air supply, although this has to be taken care of in the amount of heat supplied, as the steam must be superheated.

Aerated water has a highly oxidizing effect on metals, but humidified air, even at high temperature, has, as compared with dry air, a retarding, oxidizing effect on linseed oil, varnish and other sicative coatings. The use of ozone or ozonated air in this connection is of little use.

While textbooks state that ozone (0_3) returns to the oxygen state (0_2) at 300° F., Mr. Harrison's experience has been that at even 150° F. it no longer has the oxidizing effect of nascent oxygen. Mr. Harrison has also tried desiccating water out of materials by means of electricity, but the cost of the work was found to be out of all proportion and the action slow.

When heating gases carrying sulphur it is necessary to protect the through rods of the heater. The best mixture for this purpose was found to be Portland cement mixed with buttermilk. This will stand temperatures up to 1,200° and is flexible. Regarding the choice of fuels for drying work, as done with the Aertube heater, he said any gas or oil is easily subject to thermostatic control. Contrary to general belief, the easiest oil fuel to handle and control and the easiest on the heater and brickwork, as well as the cheapest, is the heaviest Tampico crude oil of 11 Beaume. When properly installed and heated to 160° before atomizing and when operated under thermostatic control, it gives a minimum of trouble.

This was followed by a paper on "The Temperature of Evaporation," by W. H. Carrier.

Twenty-Fourth Annual Banquet
American Society of Heating and Ventilating Engineers
Hotel Astor. New York. January 24, 1918.
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ANNUAL DINNER OF THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, HOTEL ASTOR, NEW YORK, JANUARY 24, 1918.

Wednesday Afternoon Session, January 23.

Those who attended the fuel conservation session were rewarded by an afternoon of the liveliest interest. Professor L. P. Breckenridge, of Yale University was the opening speaker and gave the members a remarkably clear view of the present coal situation and its causes and prospects, as well as many useful hints on ways and means of effecting economies in coal consumption. The address of Professor Breckenridge, who was representing the United States Fuel Administrator, was illustrated by lantern slides bristling with statistics of the coal industry, including segregations of such items as the amount of coal used by each industry, as well as the production and distribution of the coal itself. The speaker showed, for instance, that of the total amount of freight carried by the railroads, coal constitutes 35 per cent and for the eastern sections alone, it amounts to 45 per cent.

We must learn to burn bituminous coal, said the speaker, and his curves showed very pointedly the increases in the amount of bituminous coal mined, as compared with anthracite, during the past few years. Two-thirds of all the coal we use, said the speaker, goes for making steam, while 16% is used for domestic purposes.

The speaker went over in detail the various industries using coal and pointed out those that could and those that could not effect savings during the balance of the winter. He showed that the best results that could be gained by this method of estimation were about 10,000,000 tons, while the amount needed to be saved was 50,000,000 tons. How the remaining 40,000,000 tons are to be saved, is a problem, said Professor Breckenridge, which he could not solve. He said it was simply impossible to mine and deliver the extra amount needed. It would have to be saved even if it meant the closing down permanently of some of the industries.

Professor Breckenridge then took up the best way of firing heaters and had some novel suggestions to offer for running the house heater. The principal thing, he said, is to control the air going through the fire. That is the only reason for shaking down the fire, outside of keeping the fire-bed from getting too high. Therefore, the lower ash doors are not needed. They might just as well be taken off and thrown away. Plenty of control is provided by the dampers. He urged the closing or partial closing of the smoke damper all of the time.

Regarding the burning of wood in house heaters, he said that this can be done although the heaters are not properly designed for this purpose. It is advisable to get a layer of ashes on the grate as soon as possible so that the fire may be checked when desired. Wood, he added, has a heating value about one-half as much as coal.

Before finishing the discussion of his address, a paper on the same subject of fuel conservation was presented by George W. Martin, president of the National District Heating Association. Mr. Martin said that without going into the merits of the controversy on the subject of isolated vs. central power plants, it was proving a fact that at the present time a change to central plant service is proving a means of economy. Another point emphasized by Mr. Martin was the need of steam-meters for universal use. There are plenty of efficient types manufactured, he said, and they effect economies wherever installed. The Illinois Maintenance Company is putting in steam meters as rapidly as possible and the New York Steam Company is saving 25% with steam meters over the previous cost.

A measure of economy that can be widely applied is the elimination of ice from drinking water. Laundry drying can be replaced by roof drying. We can reduce indoor temperatures to 68° F. We can watch the fire more closely and obviate the need of opening the windows to cool the house. He also recommended the recirculation of air at night in warm-air furnace heated houses.

Discussing the recommendations, Professor Breckenridge said that if we would consider coal as free and air as the expensive item we would soon come to learn the vital importance of controlling the air going through the fire.

It was suggested that we develop water rates for steam heated buildings by which it could be determined how much coal certain types of buildings could get along with.

Charles R. Bishop, of the American District Steam Company, gave some figures regarding the closing down of his company's plant during the recent five-day shut-down period. He stated that it was necessary to maintain the temperature to 40° F. and, without operating the machinery the cost was only a trifle less than at full operation and maintaining 70° F.

An interesting point mentioned by Professor Breckenridge was that in the ordinary power plant 85% of the cost is in the coal. In the case of the manufacturer of some other product, such as locks, keys, etc., the cost for fuel averages only about 1%. In railroad work, fuel amounts to 5% or 8% of the total operating cost.

The discussion then turned on the matter of maintaining the desired amount of moisture in houses and W. J. Bahnson of the Normal-air Company, described an arrangement he had installed in his own residence whereby he is able to maintain between 45% and 50% relative humidity in zero weather. He uses from 1.3 to 1.6 gal. of water per hour, the house being 50x36 ft. The arrangement he uses includes a water spray and an electric fan, together with a duct leading from the top of the furnace to the spray and then back to the furnace again, re-entering the casing near the bottom. Besides adding humidity this arrangement also accelerates the circulation of the air through the furnace.

LIMITING THE FUEL SUPPLY TO INDIVIDUALS

President Lyle brought up a point that had been suggested by the Bureau of Mines of limiting the supply to individual residences. Following out this idea, Frank T. Chapman stated that a reasonable proposal in this connection would be:

One-fourth-ton per room per month, for the months of December, January and February.

One-fifth-ton per room per month, for the months of October, November and March. Baths and service rooms to be counted as half-rooms and the hall to be considered as one room. An allowance, also, would have to be made for warm and cold localities. It was voted to bring this subject to the attention to the United State Fuel Administration through the society's fuel committee so that there would be something to go on in case the necessity for such drastic action should arise. In applying the formula to their own homes several of those present found from their computations that the rule gave an average of 90% of their present coal consumption for the heating season.

A paper on the specific subject of "Economy in Fuel," was presented by Perry West.

Economy in Fuel.

Mr. West's paper, first presented to the New York Chapter, at its November meeting, was published in abstract in THE HEATING AND VENTILATING MAGAZINE for December, 1917. So many practical suggestions, however, are contained in the paper that it is presented herewith in full:

There are two general ways in which the conservation of fuel may be accomplished. One is by eliminating all unnecessary and superfluous demands, and the other is by practicing economy in the use of the fuel for such demands are absolutely necessary.

In the matter of the heating and ventilation of buildings the principal items of unnecessary and superfluous demands are:

First: the elimination of mechanical ventilation during the early fall and late spring months when window ventilation will naturally be used anyway and may be used with almost as good success as mechanical ventilation;

Second: The cutting off of heat in corridors, stairways, courts and all such places during much of the heating season and except in coldest weather, thereby not only saving a great deal of coal, but leaving these spaces in a much more healthful and exhilarating condition;

Third: By consolidating the activities in a building so as to keep the heat shut off of all sections of same, except when actually required for use;

Fourth: By eliminating such activities as require more heat than they are worth;

Fifth: By the adjustment of the human element, so as to have the coldest natured occupants of a building in the warmest sections, so as to prevent the overheating of the whole to satisfy a few.

In our school system of about seventy schools (Newark, N. J.), the above measures are estimated to effect the following savings:

Omission of ventilation during October, November, April and May................	$10,000.00
The cutting off of unnecessary heat................	2,500.00
Consolidation of activities, such as evening classes and odd classes..............	500.00
Making a total saving for these three items of.....	$13,000.00

In the matter of using fuel most economically for those requirements which are an actual necessity, there are two general ways in which this may be gone about. One is to improve the economy of operation of your existing apparatus, and the other is to improve the apparatus itself, so as to make it more efficient.

The economy of operation of most any existing plant can be improved by always keeping the units in use properly proportioned to the load, keeping the fires clean and properly proportioned in thickness to the draft, keeping loads as near constant as possible and the operating conditions in keeping with the load.

In order to intelligently proportion the units of any plant to the load, it is necessary to have complete data on all consuming apparatus and to make up an estimate sheet showing their requirements for each month in the year. With such information and a system of daily reports it will appear at a glance as to whether or not the proper number of boilers, engines, etc., are being used. We are using a draft gauge and a flue-gas testing set for determining the proper thickness of fires and as to how often fires must be cleaned and shaken to produce best results.

We are using hand damper operation on all boilers in addition to automatic damper regulation in each plant for keeping the load and operation constant, as this eliminates the wide fluctuations in draft generally prevalent when the automatic damper moves from dead shut to full open.

The system adopted for the majority of our plants is as follows:

Fires are banked in one corner of

the furnace near the bridge wall and cleaned in the morning before starting by pulling all of the dead ash and clinkers out on the floor.

The live coals are then spread over a clean grate and very lightly, but evenly, covered with fresh coal. As soon as this has burned through, a heavy layer of fresh coal is spread on and this process continued until the fire is built up, as rapidly as possible, to the most economical thickness.

After this the fire is carried as near this thickness as possible and shaken often enough to keep the ash pit bright.

Fires are cleaned at noon, and again at the end of day school in every school plant.

From results already attained we estimate a saving of $7,500 from this regulation of the firing. This added to the above figures gives a total estimated saving of $20,500, which is about 25% of the total cost of fuel, and will give some idea of what may be expected in such an undertaking. This work is being handled at a cost of less than $2,000 per year.

In the matter of improving apparatus so as to make it more economical, we have gone into the question of forced draft for burning cheaper grades of coal, temperature control for preventing the waste of heat, smokeless furnaces for burning soft coal, oil burning, gas firing, and the general repairing of apparatus, such as leaky engines, valves, etc. Under present conditions it is found that, either due to the cost of apparatus or the fuel, none of the above will show anything like the results that may be expected from the same money and energy expended in bettering the operation of existing apparatus.

There is one way of improving the economy of a ventilating plant and at the same time obtaining a much more healthful and satisfactory condition and that is by graduating the temperature of the air delivered to the rooms according to outside weather conditions. There is no question in my mind but what the average inhabitant of a ventilated room is incapable of differentiating between foul air and overheated air. Also there is no question but what the relief usually gotten by opening windows or doors is due to the cooling effect of the air so admitted. There is no reason, therefore, why we should waste the coal to heat air up to a temperature that causes a room to appear foul and then to have the windows opened and cause a further waste of heat to the outside.

In order to remedy this defect we have adopted a scale of temperatures as follows:

Outside Temp., deg. F.	Temp. of entering air, deg. F.
0	70
30	66
40	64
50	62
60	60

There is another problem upon which we are working, and that is the general overheating of buildings. This consists, *first,* of actually keeping the room too warm; *second,* of opening windows instead of cutting off radiation, and *third,* of expecting rooms to be right up to temperature at opening time in the morning.

The first of these is not only wasteful of heat, but is very detrimental to health and vitality. It is one of the ways in which we, as a race, are drifting away from any of the more rugged and invigorating environments into the soft warm spots that tend to produce a soft devitalized race. Now is a good time to realize the importance of correcting this tendency and to start a strong drift in the right direction of lower and more vitalizing living and working temperatures.

The second and third are wasteful and out of all proportion as to cost for results obtained. This is a long-drawn-out task of education, but should be dwelt upon by engineers until it is accomplished.

This was followed by a paper on "Fuel Conservation," by William M. Mackay.

Wednesday Evening Session, January 23.

Most of the session Wednesday evening was given over to the code as proposed for testing low-pressure heating boilers. The code was accepted by formal vote and thus becomes the approved practice as far as the society is concerned. The report in full, which now becomes the A. S. H. & V. E. Code for Testing House-Heating Boilers is given herewith in full:

Code for Testing Low-Pressure Heating Boilers

RULES FOR CONDUCTING EVAPORATIVE TESTS.

1. Inasmuch as the object of the test is to ascertain the amount of water evaporated per pound of coal fired, all measurements and readings should be taken in such a way as to give this result.
2. The boiler should be set up and connected to a suitable chimney flue.
3. The boiler should be thoroughly boiled out with a solution of sal soda, potassium hydrate, or sodium hydrate and then thoroughly rinsed with clean water to remove any foreign matter.
4. The piping should be connected in such a way that the steam may be carried to a point away from the boiler and piping arranged so that its condensation may not flow back to the boiler itself.
5. The separator should be attached to the flow pipe and from the bottom of the separator a pipe should be connected in such a way as to form a water seal and with an open end so that surplus water may be conducted into a pail or barrel for weighing at completion of test.
6. The piping should connect the calibrated water feeding tanks into the return of the boiler, with all necessary valves and connections, thermometer cups, etc. The water should be fed to the boiler continuously from calibrated tanks, thus showing every pound of water that enters the boiler.
7. Special care should be used in all readings.
8. Where weighing tanks are used or water is fed by gravity extra precautions should be taken to avoid error in readings.
9. Three draft gages suggested as part of the equipment, should be used to determine the pressure loss in the ash pit, pressure loss through the fuel, and pressure loss through the flues of the boiler.
10. The steam pipe from the boiler should be left open to the atmosphere so that the test can be carried on at atmospheric pressure, as we believe that running a boiler under pressure gives no more accurate results as regards capacity and efficiency than may be obtained by evaporating the water at atmospheric pressure.
11. *Starting.* It is recommended that a preliminary fire be made and the boiler run until such time as water in the boiler steams, when the preliminary fire will be dumped, the ashpit thoroughly cleaned, and air dried wood placed on the grate and kindled. The test shall be considered as starting at the time of firing the charge of wood. On this charge of wood shall be placed the coal. The wood shall be considered as having a heating value equal to 40% of that of an equal weight of coal.

The weight and temperature of the water in the boiler at the start should be recorded.

Against the boiler should be charged all of the coal and wood used during the test, and at the end of the test the boiler is to be given credit for the unburned fuel, and the quantity of water fed to the boiler during the test, less any water thrown out in excess of a quantity represented by the condensation of the pipe and separator.

12. Readings should be taken at periods not over those indicated in the log.
13. Gas analysis should be made at least every hour to get fair average results.
14. *Stopping.* When the time set for the end of the test arrives, the fire should be dumped or combustion stopped by some other method, such as spraying the fire with water. The contents of the fire pot when dumped should be placed in tightly covered cans where they may be left to cool.

After cooling, the unburned coal and ash should be separated, the unburned coal weighed and deducted from the total quantity of fuel fed to the boiler. A proximate analysis of the coal should be made in order to determine its various constituents.

RATING.

On the question of commercial rating or capacity, we have no suggestion to offer except that as a basis of comparison, the item 11 in report form appended (Fuel Available) should be calculated from area of fire box and depth to center of fire door not exceeding 20 in., less 20% for reserve, and item 12 (Time Fuel Available Will Last) figured on the basis of eight hours.

A formula for calculating rating is given by the 1913 Committee in their report and is endorsed by us in modified form as follows:

$$\frac{C \times E}{T} = \text{boiler capacity per hour in B.T.U.}$$

Where C = pounds of fuel available for one firing period;
T = time fuel available will last;
E = the total B.T.U. considered available per pound of fuel at boiler outlet, not exceeding results shown by tests.

If rating is desired in equivalent square feet direct radiation, divide capacity in B.T.U. by 250 for steam and 150 for hot water.

REPORT FORM FOR TEST OF LOW-PRESSURE HEATING BOILER.

1.—Name and catalogue rating....................
2.—Grate surface; width...., length...., area....,
3.—Date of test............No. of test.........
4.—Normal operating firing periods..............
5.—Duration of test............................
6.—Times fired..................................
7.—Longest interval between firing..............
8.—Fuel, name.....................Size........
9.—Fuel, calorific value........................
10.—Fuel capacity pounds.......................
11.—Fuel available (less re-kindling reserve)........
12.—Fuel available. Time will last, hours..........
13.—Fuel weight as fired, lbs...................
14.—Fuel moisture, per cent.....................
15.—Fuel weight fired, less moisture, lbs............
16.—Fuel weight unburned (including.. lb. recovered from ash pit)....lbs.....................
17.—Fuel burned in test, lbs.....................
18.—Fuel burned per hour, lbs....................
19.—Fuel burned per sq. ft. grate per hour, lbs.....
20.—Ashes, lbs..................................
21.—Clinker, lbs................................
22.—Combustible, lbs.............................
23.—Temperature, steam or flow, deg. F...........
24.—Temperature, feed water or return, deg. F.....
25.—Temperature, gases leaving boiler............
26.—Temperature boiler room.....................
27.—Temperature outside air.....................
28.—Draft intensity in smoke pipe.................
29.—Draft intensity over fire....................
30.—Draft intensity in ash pit...................
31.—Friction loss through flue...................
32.—Friction loss through fuel...................
33.—Friction loss through inlet...................
34.—Steam pressure in boiler by gage............
35.—Steam pressure in receiver by gage...........
36.—Percentage of moisture in steam.............
37.—Percentage of CO_2 in escaping gases...per cent
38.—Weight of water fed to boiler................
39.—Weight of water evaporated, corrected for moisture in steam........................
40.—Equivalent evaporation from and at 212°.......
41.—Evaporation per hour of test.................
42.—Evaporation per lb. of coal as burned........
43.—Evaporation per lb. of combustible...........
44.—Capacity, total available B.T.U..............
45.—Capacity per hour B.T.U......................
46.—Capacity total available sq. ft. radiation.......
47.—Capacity per hour, sq. ft. radiation...........
48.—Efficiency of boiler.........................
49.—Efficiency of boiler and grate................
50.—Losses, grate................................
51.—Losses, stack gas............................
52.—Losses, incomplete combustion................
53.—Losses, unaccounted for......................
54.—Smoke pipe, size........, Length............
55.—Chimney, size..........., Height............
56.—Draft ...., Inches............

APPENDIX

APPARATUS AND INSTRUMENTS

The apparatus and instruments used in testing should include the following:

Feed-water tanks calibrated or to be used in connection with weighing scales; air-pumps, if water is to be fed by compressed air; weighing scales for weighing fuel, ashes, etc.

Differential U-tube (with inclined leg) draft gages, at least three in number, for measuring draft tension; first, loss in draft through the fuel bed; second, loss in draft through flues.

Accurately calibrated instruments for measuring temperature of gases, water, and steam.

Steam separator for attachment to steam pipe, separator to be thoroughly covered with non-conducting material.

Blanket covering consisting of one-ply 2-lb. asbestos paper and 1-in. hair-felt which would make a desirable covering for the boiler.

Gas analysis apparatus for determining composition of the flue gases (Orsat).

Log sheets on which to keep accurate record of various readings.

The principal point of discussion before the acceptance of the report was over the method of starting and stopping the tests. Professor Breckenridge emphasized the difficulty of duplicating results with the standing start. He also found objections to the separation and weighing of the coal and ashes at the conclusion of the tests.

He also thought that better results would be secured without exhausting the steam to the atmosphere. Arthur K. Ohmes said that the code did not indicate capacities at different percentages of full load and that there should be some way of determining this.

P. H. Seward said that no effort was being made by the committee to rate boilers but only to determine their capacity. He said that the matter of a running or standing start was one on which all could not agree, even in the committee. He said he could see no objections to exhausting the steam to the atmosphere as provisions were made for catching the entrained moisture and it is an easy method of handling that part of the test, especially as the idea was to test only at full capacity.

In accepting the report it was voted to continue the committee to take care of any necessary revisions that might be found necessary after the code had been given a trial. In the meantime it will be used by society members as a standard method of testing the house-heating type of boilers.

A paper by Professor John R. Allen on "What We Do and Don't Know About Heating," was then presented, being read, in Professor Allen's absence, by H. M. Hart. A general discussion of the subject followed. It was voted to refer the paper to the research committee for its information and guidance.

Thursday Morning Session, January 24.

Thursday morning was devoted to warm-air furnaces.

A paper by D. Rait Richardson was presented on "The Engineer Has Opportunity in Furnace Heating."

"The Engineering of Warm-Air Furnace Heating," was then presented by M. William Ehrlich. Mr. Ehrlich laid particular stress on the vicious practice of connecting warm-air ducts into rectangular wall flues of smaller area than the ducts, as well as on the need of improving the design of these connections. He suggested that wall flues should always be made so that the width is not more than twice the depth.

It was brought out in the discussion that much more attention is being paid to furnace design by the manufacturers than formerly, but that there has been but little improvement in methods of installation.

On motion of Mr. Lyle it was voted to appoint a committee to formulate a code for testing warm-air furnaces and another code for their installation. This committee, it is thought, can work with the association of warm-air furnace manufacturers.

One speaker stated that heating engineers have not been giving proper recognition to the advances being made in furnace heating and might well be termed steam and hot water heating engineers. The appointment of a furnace code committee was given as an answer to this challenge.

A paper by G. S. Barrows was presented on "Answering Fuel Needs with a New Gas Heating System."

Answering Fuel Needs with a New Heating System.

This paper was devoted mainly to a description of the Rector system of gas heating, with some interesting comments on the development of gas heating and of the way the Rector system came to be put on the market. Numerous illustrations served to bring out the various points of this system.

Mr. Barrows stated that when first distributed, natural gas was so plentiful and cheap that it was burned as a substitute for coal in any make-shift burner in the heaters already in use. Natural gas was often piped through lines many miles long and under high pressures so that breaks in the lines occurred. As nearby gas fields became exhausted and the price of gas was raised, appliances designed for gas fuel became more common. Unfortunately, however, before their development had passed much beyond the experimental stage, the failures of adequate supply became so frequent that natural gas companies themselves recommended to their consumers that they install only heating appliances in which solid fuel could be used when necessary.

Another point made by Mr. Barrows was that all season or general house heating does not give an ideal load factor as it makes a heavy demand on both production and distribution and produces revenue only during a part of the year. These reasons, he said, are sufficient to explain the tardy acceptance of gas for general heating of buildings. He added that this form of heating is now being extended at a gradually increasing rate. In describing Mr. Rector's inception of his gas-heating system, Mr. Barrows said:

About 1909, Alcorn Rector, while experimenting with incandescent mantle gas lamps, particularly with the view of increasing the quantity or intensity of the light as well as the efficiency of the lamp, adopted the exhaust instead of the pressure method for augmenting the proportion of primary air in his atmospheric burners. Keen and observant, he immediately saw that the heat of the products of combustion in the exhaust pipe might be utilized in a radiator for room or space heating. Tests soon showed him that with properly-designed radiation, the system would show an efficiency unknown till then and that beyond this gain, some most desirable features of ventilation, valve operation and temperature control would be possible.

For several years Mr. Rector struggled with those obstacles usually met with by the inventor of moderate means, constantly improving his system by the slow and unsatisfactory means of fault elimination in commercial installations, until about two years ago he formed a connection with a well-known company with manufacturing ,and commercial facilities to properly build, sell and install the system. The faults of the heating units and their parts have been overcome and improvements made in them, units of several sizes have been designed, and specifications drawn up for the installation of the radiation piping, exhaust fan, etc., for a system of heating primarily adapted for the heating of a building or one large section of a building, although it is perfectly practical to install a single radiator.

Several speakers brought up the point that the temperature of the exhaust in this system would not necessarily indicate the efficiency unless an analysis was made of the products of combustion of the gas. The danger of flash-backs was also discussed, although the fact that there is always a partial vacuum in the system would tend to prevent this and also would help to prevent gas from leaking into the room. The author was requested to furnish further data regarding quantities and costs.

James H. Davis said the Rector system of gas heating was being successfully used in Portland, Oregon, in connection with Vento heaters.

Owing to the lateness of the hour the paper on "Dust" by E. R. Knowles was presented by title.

Dust: Its Universality, Elimination and Conservation.

This paper proved to be one of the most exhaustive and carefully prepared that has been presented to the society in some time. The author began by dividing dust into molecular dust, water dust, "Scriptural" dust, just "dust," smoke dust and mechanical dust. Dusts, he said, may be injurious or inert, valuable or valueless, according to their placement or source. Dusts may be injurious by their irritant action, toxic action, mechanical action, or a combination of these dust forms. Mr. Knowles then classified dusts under five general headings, based mostly on their reclamation value, while another classification was given of various dusts found in the air, in gases and fumes from various manufactories and as results of various manufacturing processes, which it is desirable to remove and collect.

The remainder of the paper was taken up with descriptions of various types of apparatus for dust separation, including some thirty different makes, all of which were illustrated and their important features described.

Thursday Afternoon Session, January 24.

The final session was opened with a paper by F. N. Speller and R. G. Knowland on "The Preservation of Hot Water Supply Pipe."

The Preservation of Hot-Water Supply Pipes.

The first portion of this paper deals with the principles involved in the corrosion of iron and steel in which it is pointed out that corrosion is purely an electrochemical phenomenon due to the fundamental nature of water itself, but aided by even a very minute acidity; that corrosion is promoted and made progressive and continuous by the action of dissolved oxygen in water, the gas acting as a depolizer and thereby carrying on the activity of the corrosion process; and that in domestic water, dissolved oxygen is the only depolizer or activator present, hence the term deactiavor may be applied to describe the apparatus used to remove dissolved oxygen from water.

The second portion of the paper is devoted to practical considerations of the subject, with special reference to the hot water piping in at Hemenway Terrace, Boston, where an installation was made for fixing the oxygen, similar to that described last year by Mr. Speller, at the Irene Kauffman Settlement in Pittsburgh. This process, it will be remembered, showed that by keeping hot water under pressure in contact with a large surface of iron for a sufficient length of time, it is possible to remove and "fix" the oxygen, rendering the water practically inactive or non-corrosive. The Hemenway Terrace installation was described in detail, the authors concluding that the effectiveness of this method of oxygen removal is obviously not limited to installations if steel or wrought-iron pipe, but that the life of brass or bronze pipe may also be lengthened in this manner. It was stated that the protection of a hot-water supply system by deactivation of the water should be undertaken as a matter of common precaution.

This was followed by a paper on "The Relation of Hot Water Service Heating to Various Types of Buildings."

Relation of Hot-Water Service Heating to Various Types of Buildings.

This paper is devoted to data by which heating engineers may make their own estimates for proportioning a hot-water supply, including the maximum number of gallons required per hour and the temperature rise expected. Figures are given covering the required number of hot-water fixtures for lavatories, baths, showers and slop sinks. These figures are then applied to hospitals, office buildings, shops and schools. Separate data are given for apartment houses. The proportion of storage to heating capacity is then taken up, the general rule being given that "the heating capacity should equal the constant load and the storage capacity should be sufficient to carry over the peak, plus 25% to be retained in the tank." Typical calculaions for a hot-water tank are presented, illustrated by a graphic representation of the calculations. The remainder of the paper is taken up with data for the heating of the tanks, using steam, gas and coal, respectively, as the heating medium.

One speaker brought up the advisability of carrying higher temperatures in domestic supply water as it will reduce waste. Users, he said, will not allow very hot water to run to waste to the extent they will waste warm water. Mr. Alt said that this would have a bad effect on fixtures that would more than make up for any economies obtained in operation.

A paper was presented on "Calculations and Analysis of a Compound Gravity Low-Pressure Hot Water System," by A. J. Wells of London.

Calculations and Analysis of a Compound Gravity Low-Pressure Hot-Water System.

By a "compound" heating system, Mr. Wells means a combination of a one-pipe and two-pipe system. The one-pipe radiators are used to increase the circulating pressure and thus diminish the pipe sizes, while the two-pipe radiators are designed to prevent any excessive temperature drop in the main pipes. The author proceeds to present the calculations to determine the circulating pressure produced by the one-pipe and two-pipe systems, adding that "the calculations of the compound system are produced from these two systems." These are gone into at great length, the author concluding with the statement that "the data required for calculating the most complicated system that could possibly be designed are contained in this paper."

This paper was highly praised by Arthur K. Ohmes who called particular attention to the resistance chart based on Reitschel's experiments. This table, he said, had been used in his office successfully for many years.

The last paper presented was on "Measurements of Low-Pressure Steam Used for Heating the Buildings of the University of Michigan," by J. E. Emswiler.

For the committee on schoolhouse standards, Frank Irving Cooper made a report at this time showing the progress made in this direction. He exhibited charts indicating that the amount of space given to heating apparatus varies up to 6%, while the variations are as much as 9½% for direct heating equipment.

A resolution was passed pledging the society to co-operation in the matter of schoolhouse standards with the National Education Association.

INSTALLATION OF OFFICERS

This concluded the technical programme and was followed by the installation of officers. H. M. Hart and John F. Hale were appointed to conduct the new incumbents to the rostrum. The new president, Frederick R. Still, was warmly greeted as he took the chair and announced that he would have to depend, more than he thought when he took the nomination, on the support of the other officers. Fifty-one engineers, he said, had already been taken from his company's plant by the government.

Speaking of the needs of the society, he urged the presentation of more papers and more written discussions. He also urged more active committee work. He said the society should also take up the standardization of specifications and prepare standard forms of guarantees.

First Vice-President Walter S. Timmis was presented as the man who would have more than the usual share of responsibility of a vice-president, owing to the business handicaps of the president.

The Entertainment.

In keeping with the spirit of the times, the entertainment features were on a moderate scale, being confined largely to luncheons and theatre parties.

The society's annual dinner was held at the Hotel Astor Thursday evening, January 24, and proved one of the liveliest and most pleasurable functions of its kind the society has ever held.

The retiring president, J. Irvine Lyle, acted as toastmaster while the speakers included the new president, Frederick R. Still, Wing Tabor Wetmore, and Lieut.-Col. T. E. Powers, Canadian Engineers, who was one of the principal speakers at the society's meeting in Chicago last summer.

In presenting Mr. Still, Mr. Lyle spoke of the society's recent achievements in connection with the proposed research bureau, in its adoption of a boiler code and in starting work on a furnace code. He also referred to the service the society was rendering the government. He introduced Mr. Still as a heating engineer of international reputation.

Mr. Still said that the war was the important thing before us for the present. Many of the navy specifications were those suggested by the society's committee. The cantonment prophesies expressed at the summer meeting regarding the dangers of disease through over-crowding have come true because the recommendations of the society were not carried out.

There should be additional chapters organized at such points as Buffalo, Pittsburgh, Cincinnati, St. Louis, Denver and Seattle. We must encourage young men to join the society and he said that there were no societies in existence where a man could derive so many benefits at so little cost.

Mr. Still said it would be years, if ever, before prices go back to what they were in 1914. The war has speeded up European output to a higher efficiency than ours and after the war is over, it will be necessary for us to effect a consolidation of units,—with uniform contracts, uniform specifications and uniform design.

America, he said, is to be the Mecca of all creation after the war.

Wing Tabor Wetmore, the next speaker, proved a most delightful entertainer and presented what amounted to a series of sketches and recitations that captivated the diners. He was followed by Lieut.-Col. T. E. Powers who had many more interesting things to say regarding his experiences in the two battles of Ypres and in the battle of the Somme. He expressed the opinion that the war must be fought to a finish in order to prevent another outbreak within a few years.

Following the speech-making, the floor was cleared for dancing.

B. K. Strader, who was in direct charge of the dinner arrangements, was congratulated on all sides for the success of his plans and R. W. Pryor, Jr., the general chairman of the entertainment committee, came in for the warmest praise for his handling the entire entertainment.

◆

America's National Fault.

Some well-expressed ideas on the subject of America's wastefulness were contained in an address delivered by Lewis E. Pierson, a prominent New York banker, before a war conference of Michigan's business men in Detroit.

"If there is one tendency," said Mr. Pierson, "which more than any other seems to menace our success in putting the nation's resources in such condition as to be able to meet the extraordinary demand which war has created, clearly it is the tendency towards national waste. Our reputation as the most wasteful nation and people in the world finds fullest justification in conditions which surround us upon every hand. Indeed, we appear to have been so impressed by nature's bountiful provision in our behalf that we have allowed ourselves to develop almost as a national characteristic a complete disregard for ordinary principles of every-day economy, which other nations have learned to include among the fundamentals of their existence.

SOLUTION NOT SIMPLE.

"Many of us appear disposed to discuss this question of national waste as though the solution were simple, and involved only a certain amount of self denial upon the part of the average citizen—as though the cutting out of luxuries in our daily life, the simplifying of the national bill of fare, the checking of extravagant tendencies in dress and in amusements would be sufficient to cover the case and serve the national purpose. Economies of this kind are vitally important and indispensable to our full success, but, after all, they represent only a very small part of what must be accomplished before this national tendency can be checked, and before more than a part of the vast wealth of this nation will be available to support our efforts in this war.

WASTE EVERYWHERE.

"Waste is everywhere—in production—in manufacture—in transportation—in purchase—in sale—in distribution. It interferes with the efficiency and proper economy of business and of Government. It is responsible for immeasurable national losses in materials destroyed—in services misdirected—in efficiency possible but not secured.

"Beginning with production—and that is the point at which Government action or correction and regulation to be fully effective must begin—we find waste. The farmer wastes when, because of careless methods, he allows grain to rot in the fields, and when because of labor or transportation or distribution difficulties of some kind, he grows fruit which never finds a market, and when he allows his cattle to reach the market in an imperfectly fattened condition, and when he tolerates land which is fallow instead of productive, and when he insists upon operating independently of his fellows instead of taking fullest advantage of the obvious benefits of co-operative organization.

UNINTELLIGENT BUYING.

"Waste is found in unintelligent buying and preparing and utilizing of materials—in money which is hoarded instead of being put into the channels of commerce for which it was intended—in commercial credit which is tied up in frozen book accounts—in the purchases of luxuries, or in extravagances which mean nothing to the purpose of war—or in the possibility of productive labor of men, or women, which is not utilized in effective manner.

GOVERNMENT WASTE.

"The Government wastes when it fixes a price so high as to permit excess profits and fails to provide a recovery tax upon the particular industry affected. It wastes when it fixes a price so low as to remove the proper incentive to the necessarily large increased production demanded by war; and it wastes when, in administering the war business of the nation, it secures from a machine, or a man, or an establishment, or a business regularly under its control, a percentage of efficiency lower than the highest efficiency of which that machine or man or establishment or business is capable; and again it wastes when, in constructing or purchasing or in any other of the war business functions with which it has been entrusted, it allows its different departments to bid against each other for labor and for vast quantities of materials and supplies, thereby creating purely fictitious values with their natural bearing upon inflation and the high cost of living, and with the disturbance to business and industry and labor which follows. It wastes when, in any form of contract, it fails to provide the incentive to economy in costs which well managed private business always is so careful to require.

COMMITTEES FOR EACH INDUSTRY.

"It would seem that nothing more quickly could secure from business its greatest value to the Government at this time than, on the one hand, the prompt organization by each essential industry, of a committee authorized to speak to the Government for the industry or questions of production, price, distribution of orders, prioity, and other matters of war importance, and on the other hand, the equally prompt creation by the Government of an organization clothed with full and properly co-ordinated responsibility and authority, which do not now exist, to direct the business operations of the war back of the forces. Such organizations to include only executives whose business capacity and experience would meet the universal approval of the patriotic intelligencies of the entire country. This organization should be charged with the duty of immediate co-ordination of the war business activities of the nation, the development of definite policies for the Government in its relations to all forms of business fundamentally related to our national interest in winning the war, and with the carrying out of such policies."

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A. S. ARMAGNAC.................... *President*
GUSTAVE PETERSEN.... *Secretary and Treasurer*

A. S. ARMAGNAC, Editor
GUSTAVE PETERSEN, Business Manager
HAROLD L. ALT, Contributing Editor

European Representative:
W. G. HOLLINWORTH, 304 High Holborn
London, W. C.

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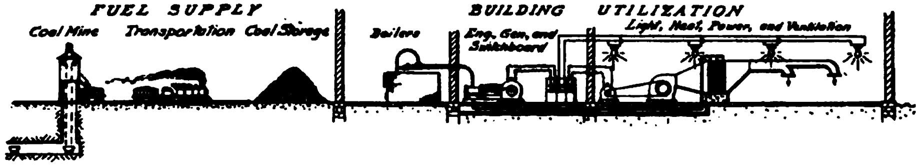
THE prospect of a heating research bureau in this country, to be conducted under the auspices of The American Society of Heating and Ventilating Engineers, and whose findings can be accepted by the public as conclusive, opens up a vista of the utmost interest to the heating profession. A good many things can be settled and taken out of the range of "claims" by this bureau. We should know, for instance, before the bureau is many years old, how to distinguish between good and bad design in various kinds of heating apparatus and appliances. New devices of exceptional merit, which now have a difficult road to follow to obtain recognition, may have their status fixed in short order. When it comes to engineering information, much of this can be standardized and this will help to eliminate the wide variations of practice that we see on all sides. If conducted properly, the bureau can give us not only the capacities of different makes of house-heating boilers, to single out one item, but their capacities at various percentages of full load, a point on which information is greatly desired. In short, the bureau has a great future before it. Broad-minded men will be needed to "put over" its findings, but in the spirit of the new day that is at hand, the undertaking has become more than possible, it has become feasible.

The details of the scheme as formulated are excellent. Dependence is not placed upon the generosity of the few, but all engineers and others interested who so desire, may have a part in the bureau's achievements. This is not the easiest way, but it is by far the most sensible. The rank and file are to pay for the work and that means they are going to see that it is properly done, without fear or favor.

Not the least important effect of the establishment of standards by so authoritative an institution is the effect this work will have on the profession itself. This, apparently has not been given a great deal of consideration. It is evident, however, that much of the aloofness and selfishness often seen among engineers is due to the fact that they believe their engineering information is theirs alone and too valuable to be given out. Their ways, they feel, are the best ways. It took them a long time to dig out their data. Let the other fellows do the same. When these men find that their carefully-cherished data and methods have become public property and are supplemented, probably, with additional information, there should be a new impetus given to the trend towards more of good fellowship and co-operation among engineers. The importance of this can scarcely be overestimated when we consider the imminent after-the-war struggle for commercial supremacy throughout the world.

POWER PLANT ENGINEERING



Selecting the Power Plant Engines

One of the most debatable points in designing a power plant for a building is the number, type, size and speed of the engines to be used and there is, indeed, much room for honest differing on this subject. Leaving the details of the various types of engines for later discussion, the number and size of the units may be regarded as the main points requiring first settlement.

As a general thing it is customary to install units of varying capacities to accommodate the different sizes of load likely to be encountered. For instance, an ordinary building may have a small day and night load from a few motors, a large night load from illumination and may, or may not, have an intermittent elevator load at all times. Indeed it does not require a very large building to employ the services of more than one elevator and this, it may be remarked, is the most difficult load to take care of in the ordinary building power plant.

The elevator motor load on starting up for direct current is usually at least 35% in excess of the rated motor capacity and for alternating current may be as high as 200%. When a generator is made two and one-half times or less of the rated capacity of the elevator motors the results are bad.

If two units are to be installed one is usually made twice the size of the other so that the small machine will carry one-third the maximum load, the large machine two-thirds and both machines together the total maximum load. With an allowable 25% overload, this means that at a pinch the smaller machine could carry 33⅓% + 25% of 33⅓% = 41⅔% and the larger machine could carry 66⅔ + 25% of 66⅔ = 83⅓% of the maximum connected load.

When three units are employed they may be rated at ¼, ½, ¾ of total load, ¼, ¼ and 1, ½, ½ and ¾ or ¼, ½ and 1.

Where four units are used they may be made ⅛, ¼, ½, and ¾ or ¼, ½, ½, ½, etc. Possibly ⅛, ¼, ¼ and 1 might work out well in some cases.

HOW GOVERNMENT FIGURES SIZES OF POWER UNITS.

The method of determining the sizes of the power units as employed by the United States Government is most interesting. As the structures in which their power plants are installed are occupied 24 hours per day, no emergency outside connection is made and to render the danger of breakdown negligible four units are generally used, these consisting of two larger generators, each able to carry the peak load, and two small units of proper size to carry the load after midnight.

It is customary in these buildings to use units of 75 to 150 Kw. capacity. The units less than 25 Kw. capacity are too small to properly carry an elevator motor load which may be suddenly thrown on and thrown off, while units of over 150 Kw. are generally too large for the ordinary building. The unit capacity is never made less than four times the rated kilowatt capacity of all the elevator motors which can be thrown on at one time.

In larger buildings where four to ten elevators may be in daily use sometimes the largest unit is split into two of equal capacity or one large unit and three of one-half its capacity may be used if conditions show such an arrangement advantageous.

SINGLE UNITS SHOULD BE SUPPLEMENTED BY EMERGENCY ELECTRIC SERVICE.

Building power plants where a single unit is used are never dependable unless emergency breakdown electric service from outside sources is put in. In such a case the unit must, of course, be large enough to carry the whole load and this large unit must be run as long as a single watt of power is being furnished anywhere in the building unless the emergency service be cut in.

DECIDING THE GENERAL TYPE OF GENERATING UNIT.

The next thing to decide is the general type of generating unit—shall it be belt-driven or direct connected, high-speed or low-speed, direct or alternating current?

By all means avoid the belted generator in the building power plant. One of the stock arguments of the public service companies against the individual plant is the dirt, dust and *noise*. A direct connected unit is more quiet, more compact, more efficient, and has less deterioration than any belt-driven device obtainable. Moreover the engine and generator are set on the same foundation, mounted on the same (or a connected) bed-plate and are in every way more liable to keep their proper position and alignment.

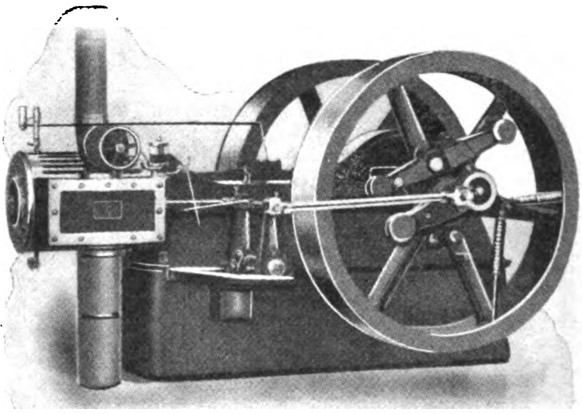


FIG. 1—SIMPLE ENGINE.
(Bound Brook Engine & Mfg. Co.)

Assumng that a direct connected unit is decided upon the next question is, what *type?* The engines most commonly used for such work consist of

(a) The simple, single slide-valve.
(b) The simple Corliss.
(c) The compound single slide-valve.
(d) The compound Corliss.
(e) Uniflow engine.
(f) Buckeye-Mobile.
(g) Gas and oil engines.

At 100 lbs. initial gauge pressure the steam consumption in pounds per hour per I. H. P. for the various types approximate the following:

	25	50	75	100	125
(a)	40.5	33.4	30.9	30.6	31.1
(b)	34.8	26.4	24.8	25.3	26.4
(c)	48.6	32.9	28.2	27.5	28.0
(d)	47.0	32.3	26.7	25.2	24.9
(e)	19.7*	19.3*	19.5*	20.0*	....
(f)	....	....	12.9**	13.3**	....

* = Initial gauge pressure of 136.4 lbs.
** = Initial gauge pressure of 208 to 210 lbs., with 171° to 192° F. of superheat.

CHARACTERISTICS OF VARIOUS TYPES OF ENGINES

A general outline of the characteristics of the various classes may be summed up in the following brief statements:

Class A is simple to operate, easy to keep in order, has few parts and is low in first cost.

Class B is more complicated, is used where higher grade operators can be secured, costs more but is less expensive to operate.

Class C is usually run condensing and on higher steam pressures; while giving greater economy than Class A, is also more expensive and complex.

Class D is suitable for larger sizes, at higher steam pressures, usually runs condensing, and is the most complicated and costly of the first four classes.

Class E seems to be a particularly desirable type of engine for steam economy and varies its consumption but little at various fractions of full load. This type is a modification of the European engine which runs condensing, and is made by only a very few manufacturers in this country.

Class F is a self-contained unit involving the mounting of the engine on top of the boiler (somewhat after the manner of the railroad locomotive, but inverted) and employs superheated steam.

This subjects the engine to—of necessity—being located in the boiler-room, with its accompanying dust and dirt, and does not

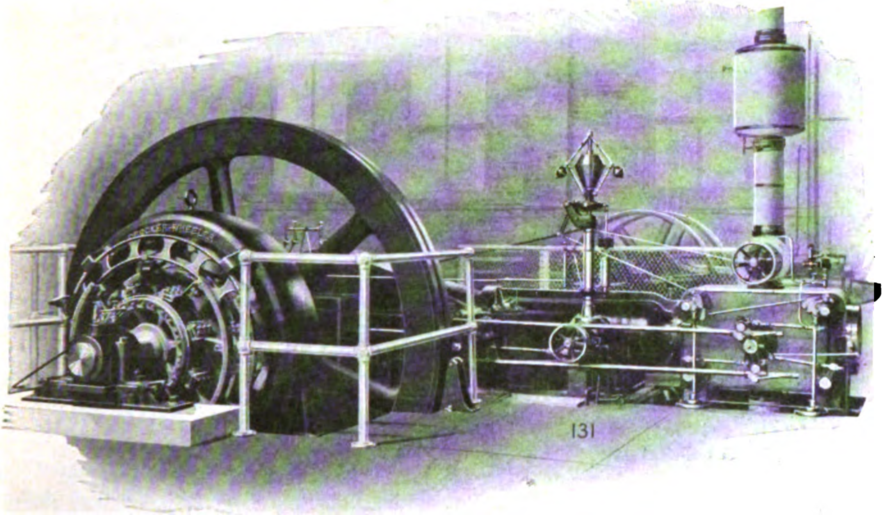


FIG. 2—SIMPLE CORLISS ENGINE.
(Vilter Mfg. Co.)

provide the engine and generator with the heavy masonry foundation obtained in all the other installations. While used to a considerable extent in factories this arrangement cannot be recommended for public buildings.

Class G is not recommended on account of the dangers attending the handling and storage of gas and oil fuels.

HIGH EFFICIENCY NOT NEEDED WITH EXHAUST STEAM HEATING.

If the exhaust steam from the engine can be utilized throughout the winter—or, better yet, all the year round—there is, indeed, no particularly great saving to be made by installing a highly *efficient* engine. For the *more* the engine takes out of the steam and transforms into *work*, the *less heat* there is left in the exhaust for heating; and the fewer number of pounds of steam *used* by the engine the *less* exhaust there is to utilize and the bigger the amount of makeup steam supplied from the boiler through the reducing valve.

It is quite a question whether engineers have not for a long time been working on the wrong end of the steam problem and, instead of expending their energies in cutting down the steam consumption of the steam engine, whether they should not have devoted their endeavors to more efficiently utilizing the exhaust.

At a vacuum of 29.5 (which is much higher than can ever be obtained in practice) a pound of steam contains a total of 1083 B. T.U., while at 100 lbs. gauge it contains 1189 B. T. U., showing that a perfect engine could not utilize more than 1189—1083 = 106 B. T. U. unless part of the steam is condensed—which really is the case to a small extent. Thus, with the exception of this small amount of engine condensation,

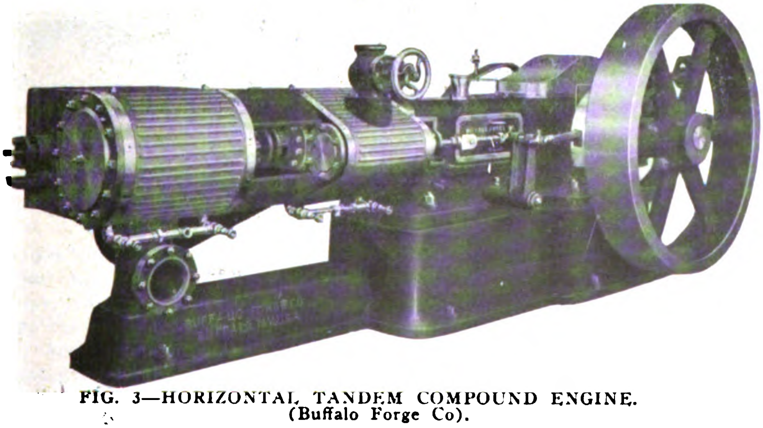


FIG. 3—HORIZONTAL TANDEM COMPOUND ENGINE.
(Buffalo Forge Co).

it is impossible to ever utilize much over 106/1189 or about 9% of the heat in the steam; with higher steam pressures possibly as high as 15% may be utilized, but this is probably the limit.

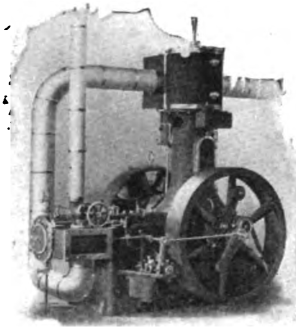


FIG. 4—ANGLE COMPOUND ENGINE.
(Bound Brook Engine & Mfg. Co.)

Thus the heating and ventilating engineers who are utilizing the exhaust steam in useful and necessary heating work are laboring in a much more fertile field than can ever be developed on the engine end. They are handling 85% to 95% of the B. T. U. obtained from every pound of coal burned while at the best the steam engine can never use over 15% and some do use as low as only 5%.

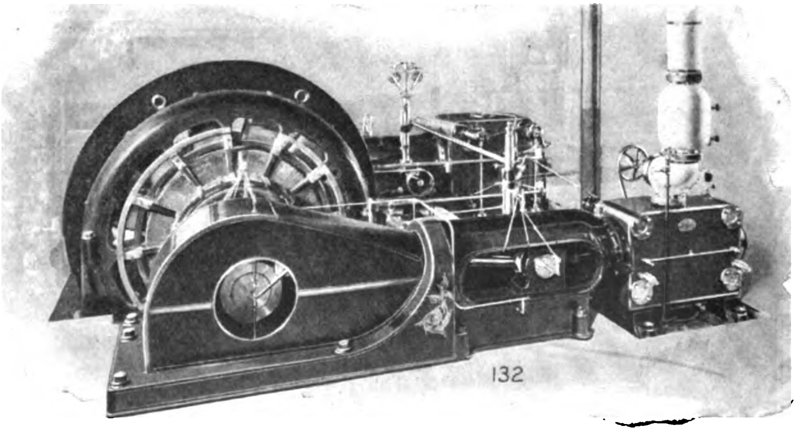


FIG. 5—CROSS-COMPOUND CORLISS ENGINE.
(Vilter Mfg. Co.)

From this it can be seen that the use of condensing engines—which throw away in the condenser water about 90% of the heat they receive in the steam—are not desirable in a combind heating and power plant, which all power plants should be. If a summer use for exhaust steam—such as for refrigeration and air cooling work—can be developed this argument assumes even greater force. This, then, leaves the matter that for such combined heating and power installations the simplest—and, fortunately, the cheapest—type of unit to use is the *best* almost *regardless* of its economy. Such a unit is covered by the engines embraced in Class A.

LEGAL DECISIONS

Unprotected Steam Pipe

The owners of a steam-heated apartment building failed to place a tap upon the open end of a radiator pipe in an apartment after removing the radiator therefrom in the spring, although the attention of the owners' foreman and of the janitor of the building was called to the matter. In consequence thereof when steam was turned on in the building in the fall during the absence of the tenant of the apartment, his property was damaged by steam which issued from the unprotected pipe. It was held in an action for damages by the tenant, that the unprotected condition of the pipe was the result of a positive wrongful act on the part of the owners' employees. The provisions of the lease exempted the owners from liability for any damage occasioned by steam and water pipes, "except from the positive wrongful act of the lessor herein or his employees." It was held that a verdict for the plaintiff was sustained by the evidence. *Dickey* v. *Wells*, 203 Ill. App., 305.

Workmen's Compensation Law—Installation of Heating Apparatus

In a proceeding under the New York Workmen's Compensation Act for personal injuries the claimant was the superintendent of an apartment house, and part of his duties was to make such repairs as he could and operate the boilers which supplied the steam heat to the premises. He went into the storeroom in the basement to obtain a radiator to be put in an apartment in place of one which was complained of as cold. In lifting the radiator it fell and crushed one of his toes. Was the employee at the time of injury engaged in any employment or work covered by the Compensation Law? Group 42 of section 2, as it existed in January, 1916, specified "plumbing, sanitary or heating, engineering and covering of pipes or boilers." The lifting of a radiator to connect it up for heating purposes was not heating engineering nor the installation and covering of pipes or boilers. That such work was not included within these terms is evident from the amendment to the law passed subsequently and in the same year. Laws 1916, c. 622, Group 42, was, amended so as to read "plumbing, sanitary lighting or heating installation or repair"; and the word "engineering" was dropped. So, too, group 22 was amended by the same act to include "heating and lighting." The words "maintenance and care of buildings" were not added to group 42 until 1917. Laws 1917, c. 705. *Kammer* v. *Hawk*, New York Court of Appeals, 117 N. E., 576.

Regulation of Foreign Corporations

The Michigan Supreme Court holds, *B. F. Sturtevant Co.* v. *Adolph Lettelt Ironworks*, 163 N. W., 13, that where a ventilating system which a foreign corporation sold and agreed to install in a school building had no such intrinsic or peculiar quality or inherent complexity as to require an agreement to install in order to effect sales generally, the contract was not within the exception in favor of interstate commerce contained in the Michigan statute of 1907 prescribing the conditions on which foreign corporations may be admitted to do business in the state.

Architect's Certificate.

In mechanic's lien proceedings by a subcontractor, the architect's certificate, made pursuant to a contract provision, that the owner did not owe the general contractor, is conclusive in the absence of fraud. *Maddux* v. *Buchanan*, Virginia Supreme Court of Appeals, 92 S. E., 830.

Necessity for Franchise and Consent of Commission.

The New York Public Service Commission holds, *Re Collins Light, Heat & Power Company*, Case No. 5749, that a light, heat and power company cannot lawfully operate in a town in New York State until a franchise has been granted it by the authorities and permission given by the commission to proceed thereunder; and that permission should not be granted a public utility to make extensions in such a way as to prevent another corporation from making any further developments in territory naturally tributary to it.

It also holds, *Colliers Light, Heat & Power Company*, v. *Oneonta Light, Heat, & Power Company*, Case No. 5672, that such a company cannot, without the consent of the commission, extend operations into an adjacent municipality in which it has no franchise, even if it may do so without occupying the public highway.

CORRESPONDENCE

Another Garage Heating Problem.

EDITOR HEATING AND VENTILATING MAGAZINE:

I wish to heat with hot water—ordinary two-pipe gravity system—a residence of say 1,000 sq. ft. of radiation (and also a garage some 25 to 40 ft. away) with the same apparatus. I should like to know the best way of running the feed and return pipes which shall be 3 ft. below grade between the two buildings; the basement floor is 4 ft. below grade and the radiation in the garage about 200 sq. ft. The boiler is about 25 ft. from nearest wall to garage. Should the garage be supplied from an opening in the boiler or header for itself? May it be taken from the end of a main? Is there any advantage in running a special riser to the top floor of residence,

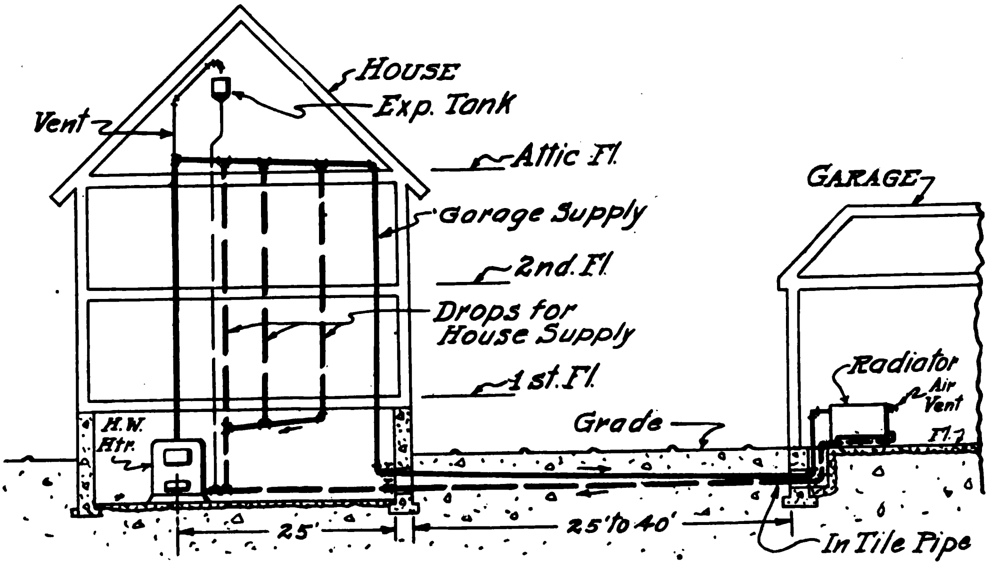


FIG. 1—CONDITIONS OF GARAGE PROBLEM.

then venting it, and running it down to basement and thence to garage. A. F.

Chicago, Ill.

Our correspondent is on the right track when he speaks of carrying the supply to the garage up to the top floor of the residence before attempting to take it across to the garage. In fact, this is the only way in which he will secure successful circulation.

As nearly as can be ascertained from his letter the conditions exist about as shown in Fig. 1, and it is suggested that, to facilitate the combined installation, the down-feed system be used in the residence. This means that all the hot water is carried to the top of the house in one main riser, as shown in Fig. 1, the top of the riser constituting the highest point of the circulating system, this high point being vented by the vent line carried up and turned down over the expansion tank.

The feed main for the house slopes downward constantly from this point to the various drops supplying the house radiators and to one separate drop for the garage—no house radiator connections being made to this drop. The drop is carried as straight down as possible to the level where it leaves the house to cross over to the garage.

This cross-over should be laid in tile pipe to protect the covering on the hot-water lines and to allow proper expansion, the supply line being graded down toward the garage and the return line down toward the house. In the garage, rise up and connect to one or more radiators as shown, avoiding all pockets in the piping and providing for the relief of the air collecting in the top of the garage radiator by a small air vent, as shown. It may be found easier if each pipe to and from the garage is laid in a separate 6 in. tile line so as to facilitate the grading of same.

In the *house* the house drops are usually made as shown in Fig. 2, the supply drop diminishing in size as the various radiators are taken off from it and the return drop increasing in size as the returns from the various radiators are received into it. In

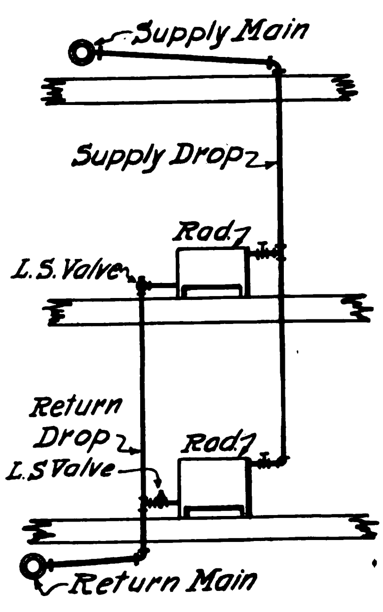


FIG 2—USUAL ARRANGEMENT OF HOUSE DROPS.

good work on the return from each radiator a lock-shield valve is installed for the purpose of adjusting the flow between the various radiators so that one will not rob the circulation to another. In this way accurate adjustment can be secured and, owing to the radiators being vented through the supply line, no air vents are necessary.

The two valves shown controlling the supply and return from the garage just inside the house wall should have 1/8 in. or 3/16 in. hole drilled through the gates so, even if closed to keep the radiators cool in a garage, there would still be enough circulation through them to prevent freezing upon a sudden change in the weather.

If the construction of the house does not permit the use of the overhead main the scheme shown in the corresponding column of The Heating and Ventilating Magazine for January, 1918, is also recommended for this case.

Back Draft in Chimney

Editor, Heating and Ventilating Magazine:

In The Heating and Ventilating Magazine for December, 1917, under the caption of "Back Draft in Chimney," there is a question from a correspondent as to the cause and remedy of down draft in one of three flues built together. The conditions are: two outside chimneys on opposite sides of a dwelling (two-story and basement) with an open fireplace on each floor. One of these chimneys has but one flue and this connected to a hot-water boiler in the basement; the other has three flues each connected to a fireplace. The one to the basement and, therefore, the longest, has a down draft, while all the others have good draft. Radiation in the basement is hung on the ceiling and the down draft tends in the direction of an open stairway extending to the upper floors. There is also a perceptible flow towards a door which opens into the boiler room. Opening the outside boiler room door does not remedy the difficulty.

In the reply to the correspondent sketches are shown and various suggestions are offered. By the process of elimination and quoting from certain paragraphs, we may dispose of these as follows:

"The correspondent displayed good reasoning in trying the experiment of opening the outside boiler-room door 'D' but if this door happened *at that time* to be on the lee side of the building it might have made conditions worse instead of better. With the wind blowing *against* the boiler-room side of the house it is thought that no trouble will be experienced with this flue, especially if the doors between Room A and the boiler room should be left open."

"Third, the air supply for the boiler must be taken to a great extent out of the basement, there being but one door and window in the boiler-room which would hardly provide sufficient leakage to supply the necessary air for combustion."

"Also look into the matter of making the boiler-room door fairly air tight and, if necessary, place a small register face in the outside door panel of door 'D' to supply the air necessary for combustion."

It is apparent that the suggestions made in the last paragraph would not be effective if the conditions as outlined in the first paragraph exist. The correspondent also stated that he experimented by opening the outside boiler room door. It is evident that the wind does not blow on the boiler room side of the dwelling.

Your reply also states:

There are several features shown in our correspondent's sketch which might help to produce the back draft in the chimney flue as described. In the first place, the chimney is an outside one with one side and two ends exposed to the outer temperature, which will, of course, have a tendency to cool the flues and cause a reverse draft unless heat is supplied at the bottom more rapidly than it is radiated on the way up.

In the second place, the other flues in the same chimney are all connected to fireplaces which are undoubtedly used only intermittently, resulting in the chimney getting very cold and so reducing the temperature of the air in the flue that its weight becomes greater than the air in the house thus producing a reverse draft. * * * In conclusion, it might be said the reverse drafts in outside chimneys from fire-places are rather common due to the chimney getting chilled between times when the fire-places are out of use.

The comments in the above paragraphs in regard to intermittent operation and cooling surfaces are applicable to all three fireplaces and flues. As the same conditions applying to the reversed flue are present also with those of good upward draft, this does not appear to afford a satisfactory explanation of the difficulty. However, there is, in this respect, a partial explanation. The two flues with good draft, being from fireplaces on upper floors, have less lineal feet of frictional surface, less exposure to the outside air and wind to cause cooling of the flues and a less height of column for air if it does become cold due to intermittent operation. Of the upper two flues one is located between two others, therefore two of its sides are protected from cooling by air in motion or otherwise, but it may be affected slightly by cooling on one side from the reversed flue currents. The flue from the topmost floor has the same exposure as the reversed flue, with the exception that its height is the shortest of all the flues, and one side is next to a hot flue. However, some of the advantages obtained, as outlined by the flue sides being next to the other hot flues, will not be present if the upper fireplaces are not in continuous use. In this connection, it may be that the fire in the basement fireplace is intermittent, whereas the others, being in upper living rooms, are practically continuous.

"As near as can be judged from the sketch, the most satisfactory solution of the trouble will probably be found in providing a ventilator top of the positive suction type and connected to the reversed flue alone."

This is one remedy providing the suction action of the ventilator is more powerful than the opposing currents in the stairway and the wind is always blowing. The ventilator would act as a check valve and prevent a downward flow of air, but it still must oppose the action of upward currents in the hall shaft and overcoming these produce its own draft. The ventilator might effect the same results as a closed damper in the flue, no down draft and no up draft.

"It is not thought that the correspondent's suggestion of capping all the flues at the top into a contracted opening, as shown in Fig. 2, will give any relief. The usual result of such procedure is the pulling down of the smoke from the other flues into the reversed flue resulting much more disagreeably than when only cold air is drawn down as at present."

The above is true if the down draft is powerful enough to pull the heated gases and smoke from one or both of the other two flues downward with it. Heated air does not readily flow downward and should this occur there would no longer exist any down draft of any strength for the column of cold air in the flue has then been replaced by one of fairly high temperature having a tendency to rise.

"It is not likely that the radiators placed on the ceiling of the basement will affect the matter at all."

The writer believes that an error has been made in thus disposing of this phase of the situation. The air, being heated at the ceiling, will remain at that point, as it is well-known that ceiling radiators affect one's head annoyingly by radiation and that except where there is machinery in motion, cranes, etc., as in industrial plants, there is no air circulation and effective heating. This is due to the natural law of gravity. In this instance, the heated air from the many coils has a strong tendency to rise and, traveling along the ceiling, leave the various rooms through exits as afforded by openings at tops of doorways, or by transoms, if there are any. If the radiators were on the floor, the heated air would tend to rise up the fireplace, assist the draft and maintain the flue temperature. As it is, the heated air takes ready advantage of this line of least resistance and, being unrestricted, rises and finds no ventilators or upper outlets for escape except that afforded by the open fireplaces on the upper floors.

Tenants on upper floors usually leave their doors to inner halls open, thereby heating their rooms. Many a five- or six-story building has been heated uncomfortably at the top due to elevator or stairway shaft causing powerful up drafts, and it is for the elimination of odors that kitchens in modern hotels and department stores are located on upper floors.

As to the flue from the hot water boiler, this being in continuous use remains well heated. It also affords passage for high-temperature gases, which would arise from a grate of large area having a comparatively high rate of combustion. When the correspondent opened door "D" possibly he did not note whether the air continued to travel under the doorway to the boiler room flue, this having the strongest draft of all flues, except the stairway shaft considered as a flue.

In regard to the intermittent use of open fireplaces, it is sometimes difficult to heat up a radiator once it becomes cold. Though from different causes, still it is so with heated air. Once it is started along a well-defined course, it generally continues in that direction. A new or green chimney, especially in cold weather, will never have a perfect draft until it becomes perfectly dry which sometimes requires three or four weeks.

As to remedies, eliminating the ceiling radiation and substituting floor radiation is out of the question except possibly in Room "A." However, the correspondent could shut off steam to the coils in this room or in all rooms and note the results, or again he could install a small register or grille in the reversed flue at the ceiling line. This would serve as an outlet for the air which, heated by ceiling coils, will not drop to the fireplace opening, although it would waste the heat of these coils. A gas jet located a few feet up the flue and burning prior to starting the fire might be of help. However, taking the trouble at its source, why not tightly seal the doorway leading from Room "A" and provide necessary air from the window in this room. Further, the openings around doors of rooms in the upper floors, or even that to the boiler room, could be tightly closed so that the tendency for down draft would cease.

New York. T. W. R.

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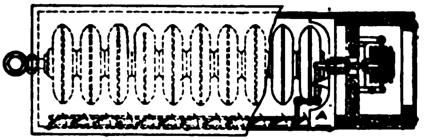
New Methods in Temperature-Control Practice.

In a recent issue of THE HEATING AND VENTILATING MAGAZINE a correspondent called attention to the fact that while large buildings are equipped, during construction, with an automatic heat-regulating system, such as the well-known methods of compressed-air control, such systems are rarely installed in old buildings, because of the cost and inconvenience which would result from the tearing up of floors and plaster in order to lay the air pipes.

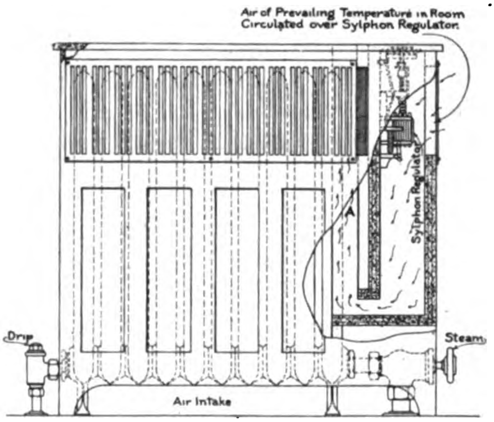
In reply to this correspondent it was pointed out that several methods of individual radiator control have been developed within recent years. In addition to those mentioned, one of the most interesting individual unit-control systems has been brought out by the Fulton Company, of Knoxville, Tenn., under the name of the "Ja-Nar." This system makes use of a radiator covering made of pressed steel, equipped with louvres which are under the control of a thermostat placed in the room and as near the radiator as may be desired. This system constitutes a separate and selective method of room heat regulation for buildings equipped with direct steam or hot water systems, at the same time fully concealing the radiator, as the covering is paneled and finished in grained or plain baked and polished enamel.

When used with this method of heat-regulation, the thermostat is placed directly in the current of the inflowing room air, as shown in the sketch. Being set to expand at rising temperatures between 60° and 70° F. and conversely, to contract on lowering temperatures between these limits, the thermostat travels forward or backward as the incoming air strikes upon its surface and operates to open or close a series of louvres which extend across the front of the covering. When these louvres are open, circulation of air by induction is at once established from the main air inlet at the base of the covering, and heating of the room by convection follows.

When the room temperature rises to the desired degree the thermostat will attain its normal position, causing the louvres to close and stopping the circulation of air over the coils. It is stated that a temperature regulation to within 2° can be obtained in this manner.



Half Plan & Section


Air of Prevailing Temperature in Room Circulated over Sylphon Regulator
A
Sylphon Regulator
Drip
Steam
Air Intake

Front Elevation Showing Operating Device

ARRANGEMENT OF TEMPERATURE CONTROLLING MECHANISM IN JA-NAR RADIATOR CABINET

One of the notable results of this operation is the effect on the enclosed air when the louvres are entirely shut. The flow of air over the radiator at once ceases with the result that the air within the enclosure attains practically the temperature of the steam so that condensation ceases.

◆

Daylight Saving Bill Before Congress.

The severity of the present winter in most sections of the country has given an impetus to the agitation in favor of the passage of the daylight saving bill, now pending in Congress. Twelve European countries, including England, France, Germany, Austria-Hungary and Italy have adopted this plan, as has also Australia. As is well-known, the plan proposed in the bill is to turn the hands of the clock ahead one hour.

America's Coal Crisis

Heating engineers are familiar with the course of recent events in connection with the coal-saving orders issued by the national fuel administration. How the Monday holidays, running from January to March 28, affect office buildings is illustrated by the accompanying announcement affecting the building in which THE HEATING AND VENTILATING MAGAZINE is located in New York.

IMPORTANT NOTICE

Until further notice this building will be operated in strict accordance with the orders of the **National Fuel Administrator.**

On Mondays
Beginning January 21, 1918

there will be no heat, elevator service or light supplied, except as follows: that which is absolutely necessary for the protection of the building, and to such occupants as are permitted by the order to have such service.

The building will also be operated in strict accordance with orders of the **Fuel Administrator of the State of New York,** as follows:

OFFICE BUILDINGS

1 No live steam will be used for heating between the hours of 7 P. M. and 7 A M. on each business day.
2. No live steam will be used for heating on Sundays and holidays.
3 Electric lighting to be cut down at least 25%.

Exception: Live steam may be used during the above restricted hours only for the protection of the property

STORES, LOFTS AND MERCANTILE BUILDINGS

1. No live steam will be used for heating between the hours of 6.30 P M. and 6.30 A. M on each business day
2. No live steam will be used for heating on Sundays and holidays.
3. Electric lighting to be cut down at least 25%
4. Interior show window lighting shall be discontinued after 7 P M., excepting such lighting as is necessary for the protection of the property

Exception: Live steam may be used during the above restricted hours only for the protection of the property

CRUIKSHANK COMPANY, Agent
141 BROADWAY NEW YORK CITY

TYPICAL NOTICE POSTED IN NEW YORK OFFICE BUILDINGS.

THE ACTION TAKEN IN BOSTON

The action taken in Boston just previous to the shut-down order of Dr. Garfield is of more than passing interest. This order was issued by James J. Storrow, fuel administrator for New England, on January 9 and went into effect at once:

"Office, banking and other business buildings shall not be heated on Sundays and holidays or on Saturday after 12 noon, or on other days after 5 p.m., except sufficient to prevent freezing. No elevator service shall be given on Sundays, holidays or between 6 p.m. and 7 a.m. on other days.

"All wholesale, retail and other business houses and stores shall open at 9 a.m., and close at 5 p.m., for doing business with the public, with the following exceptions: Dry goods, department, clothing and variety stores whose regular practice has been to remain open after 7 p.m., one or more evenings a week, may remain open until 10 p.m. on Wednesdays and Saturdays. Other retail businesses, whose regular practice has been to remain open evenings after 7 p.m., shall close not later than 10 p.m. Pharmacies may remain open after 10 p.m., but shall not use electric light exceeding a total of 100 watts after 10 p.m. Markets and grocery stores may remain open until 10 p.m. on Saturdays and until 6 p.m. on other days.

"Theatres, motion picture houses, bars, bowling alleys, billiard halls, public and private dance halls and all places of amusement shall close at 10 p.m. Theatres and dance halls may open earlier than usual.

"Every night except Saturday shall be a 'lightless night.' 'White Way,' cluster or other decorative street lighting is forbidden.

"These orders shall not apply to government work, and further exceptions to them may be granted in cases of public necessity.

"It is also recommended:

"That the business for the day end at 5 p.m. and evening activities end at 10 p.m.; many public institutions desirable under ordinary condition should be closed and others curtailed; schools should be put on a one-session basis as far as practicable.

"Factories should arrange their hours to save daylight and to relieve peak load. Salaries and wages should not be reduced on account of these orders and recommendations."

THE GARFIELD SHUT-DOWN ORDER

The principal requirements of the Garfield shut-down order are also presented herewith to give our readers a permanent record of a situation that will probably not arise again in the lifetime of the present generation:

Until further order of the United States Fuel administrator, all persons selling fuel in whatever capacity shall give preference to orders for necessary requirements:

A—Of railroads;

B—Of domestic consumers, hospitals, charitable institutions, and army and navy cantonments;

C—Of public utilities, telephones and telegraph plants:

D—Of ships and vessels for bunker purposes:

E—Of the United States for strictly governmental purposes, not including orders from or for factories or plants working on contracts for the United States;

F—Of municipal, county or state governments for necessary public uses;

G—Of manufacturers of perishable food or of food for necessary immediate consumption.

The order further provided that on January 18, 19, 20, 21 and 22, 1918, no fuel should be delivered to any person, firm, association or corporation for any uses or requirements not included in the foregoing list until the requirements included in the list should have been first delivered.

On January 18, 19, 20, 21 and 22, 1918, and also on each and every Monday beginning January 28, 1918, and continuing up to and including March 25, 1918, no manufacturing plant shall burn fuel or use power derived from fuel for any purpose except—

A—Such plants as from their nature must be continuously operated seven days each week to avoid serious injury to the plant itself or its contents.

B—Manufacturers of perishable foods.

C—Manufacturers of food not perishable and not in immediate demand, who may burn fuel to such extent as is authorized by the Fuel Administrator of the State in which such plant is located or by his representative authorized therefor, upon application, by the United States Food Administrator.

D—Printers or publishers of daily papers may burn fuel as usual excepting on every Monday from January 21 to March 25, 1918, inclusive, on which days they may burn fuel to such extent as is necessary to issue such editions as such papers customarily issue on important national legal holidays, and where such papers do not issue any editions on a holiday, they are permitted to issue one edition on the said Mondays.

E—Printing establishments which were allowed to burn fuel on January 18, 19, 20 and 22, to the extent necessary to issue current numbers of magazines and other publications periodically issued.

On each Monday, beginning January 21, 1918, and continuing up to and including Monday, March 25, 1918, no fuel shall be burned, except to such extent as is essential to prevent injury to property from freezing, for the purpose of supplying heat for:

A—Any business or professional offices, except offices used by the United States, State, county or municipal governments, transportation companies, or which are occupied by banks and trust companies or by physicians or dentists.

B—Wholesale or retail stores, or any other stores, business houses or buildings whatever, except that for the purpose of selling food only, for which purposes stores may maintain necessary heat until 12 o'clock noon, and for the purpose of selling drugs and medical supplies only, stores may maintain necessary heat throughout the day and evening.

C—Theatres, moving picture houses, bowling alleys, billiard rooms, private or public dance halls, or any other place of amusement.*

On the above specified Mondays, no fuel shall be burned for the purpose of heating rooms or buildings in which liquor is sold on those days.

No fuel shall be burned on any of the foregoing specified Mondays for the purpose of supplying power for the movement of surface, elevated, subway or suburban cars or trains in excess of the amount used on the Sundays previously thereto.

The order provides that nothing in this order shall be held to forbid the burning of fuel to heat rooms or such portions of buildings as are used in connection with the production or distribution of fuel.

The State fuel administrators are authorized by the order to issue orders on special applications for relief, where necessary, to prevent injury to health or destruction of or injury to property by fire or freezing.

The order is effective in all of the territory of the United States east of the Mississippi River, including the whole of the states of Louisiana and Minnesota.

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* The closing day for this class of buildings was changed to Tuesday.

The War and the Heating Engineer

Illinois State Council of Defense Issues Heating Rules.

A 4-page circular has been issued by the Illinois State Council of Defense, containing abstracts of the recent bulletin published by the Engineering Experiment Station of the University of Illinois on "The Economical Purchase and Use of Coal for Heating Homes." The rules are given with special reference to conditions in Illniois. Among other things the bulletin states:

No system of heating can be economical unless a careful inspection of the building is made and every precaution taken to prevent the entrance or inleakage of cold air around the windows and doors, especially those on the windward sides. Whenever cold air leaks into a house an equivalent volume of warm air leaks out, and the heating plant must make up this loss of heat.

In frame buildings the outside walls should not only be air-tight, but the air spaces between the studs should be completely closed off at the basement and at the attic, so that air currents cannot pass up through these spaces.

Under "Operation of House Heaters" it is stated:

(1) Heating surfaces should be kept clean and free from soot and ash accumulations, and the entire ash-pit should be cleaned daily.

(2) Grates should be true and not warped, should move easily, and should have no broken places for coal to drop through. Unburned or partly burned coal should not appear in the ashes at any time.

(3) The fuel pot should be kept full with fire surface at the level of fire door; let ashes accumulate on (not under) the grate in mild weather. Grates should not be shaken too long nor violently; and clinkers should be removed with as little disturbance of the fire as possible. *Do not shake or disturb a very low fire until you have added and ignited a little fresh fuel.*

(4) Anticipate the heating demand by firing promptly when the outside temperature *begins* to drop, or the wind increases. Do not allow a fire to burn too thin nor to develop holes in the fire bed.

(5) If the heater is small for its work, do not use coal containing a large amount of fine material.

(6) The house should be kept at a uniform temperature and should not be allowed to cool down more than ten degrees at night.

(7) The temperature of all rooms should be as low as is consistent with comfort. To heat a house to 75° F. instead of to 70° F. with an average outside temperature of 40° F. for the entire heating season means a 17% increase in fuel consumption.

Wood Versus Coal.

The United States Fuel Administration in co-operation with the Departure of Agriculture has inaugurated an intensive campaign for the substitution of wood for coal. The action is taken as a means of conserving the coal supply and experts from the fuel administration estimate that the utilization of the nation's vast available wood supply would go far toward meeting the shortages of 50,000,000 tons in the nation's coal supply.

In this connection it is announced that the Department of Agriculture will provide the services of expert foresters who will supervise cutting of wood so that no damage may be done to growing timber and that the largest use may be obtained of the supply of wood.

One cord of hard wood is equal to a ton of coal, according to the experts of the fuel administration. One ton of coal is released for use in war work for every cord of wood substituted. The Department of Agriculture and the fuel administration have statistics showing that there is a vast quantity of dead wood in many sections of the country and that the supply of wood in many communities is sufficient for domestic purposes in those parts. This wood in many instances is destroyed as waste and its conservation would not only serve the patriotic purpose of conserving coal needed to win the war but will also prove a measure of economy to the users.

Needs of U. S. Public Service Reserve.

The army and navy staff departments continue to need men of engineering experience, especially in industrial lines, says an announcement made by Henry N. More, publicity director of the United States Public Service Reserve, in Washington. At present the outlook is that the demand will continue throughout the period of the war. The reserve keeps on file the records of men willing to serve when called and points out that this service enables one to keep in touch with his own profession while, at the same time, he becomes a commissioned officer. It is also pointed out that the service is usually in the United States.

Opportunities for Civilian Workers in the Ordnance Department.

Several thousand civilian workers are called for, in addition to those secured up to date, for service in the Ordnance Department, in Washington. The United States Civil Service Commission is conducting an extensive campaign to obtain this needed help. Among the clerical positions open are the following: 2,000 stenographers and typewriters, men and women, $1100 to $1200 a year; 2000 typewriter operators, men and women, $1100 to $1200 a year; 200 general clerks, men and women, $1100 a year; 500 index and catalogue clerks, men and women, $1100 to $1200 a year; 200 clerks qualified in business administration, $1200 to $1500 a year; 300 schedule clerks, men and women, $1400 to $1600 a year; 300 production clerks, not more than $1500 a year; 100 statisticians, $1800 a year; 100 multigraph operators, men and women, $1000 to $1200 a year. There are also wanted 200 engineers of tests of ordnance material, $1500 to $2400 a year, an equal number of assistant engineers; also 500 mechanical draftsmen, $800 to $1800 a year; 50 gauge designers, $2000 to $3000 a year; and 100 apprentice draftsmen, $480 a year. A large number of inspection positions are also open.

Heating Men in Military Service.

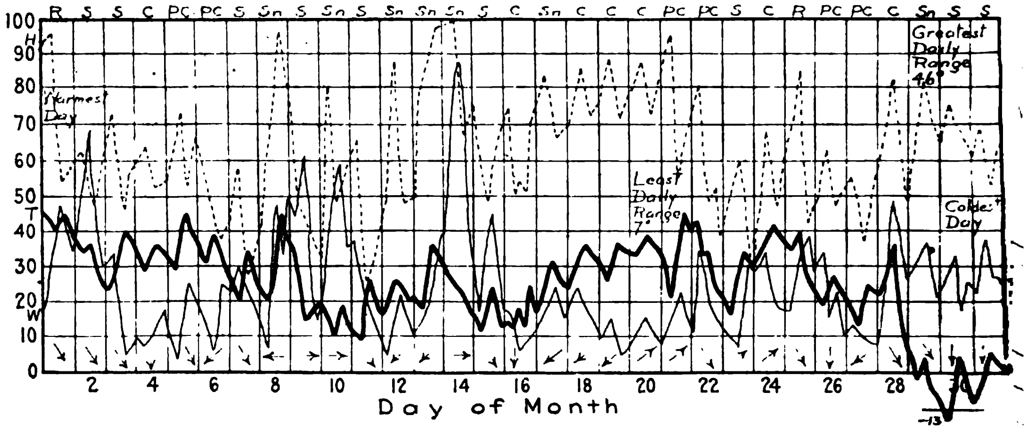
Guy E. Tripp, heretofore chairman of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has been appointed by the War Department as chief of the Production Division of the Ordnance Department, intrusted with the task of supervising and stimulating the production of all ordnance supplies. The appointment of Mr. Tripp is one of the important steps in the reorganization of the Ordnance Department, announced recently by its chief, General Crozier. Mr. Tripp was selected because of his experience in the manufacture of munitions of all kinds, the Westinghouse company having filled large contracts from the British and Russian governments immedately on the outbreak of the European War. Mr. Tripp is credited with bringing to the department the highest obtainable type of experience and ability to insure speedy and careful production of munitions. The board of directors of the Westinghouse company has given him a leave of absence for the duration of the war.

COLONEL GUY E. TRIPP
Chief of Production Division, Ordnance Department.

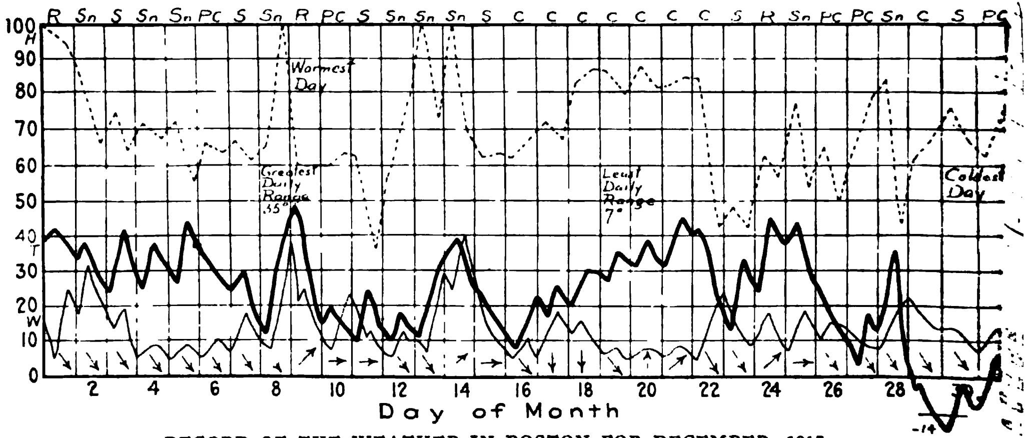
H. H. Hegeman, formerly of the Chicago office of the Kelly & Jones Co., Pittsburgh, has received his commission as second lieutenant in the regular army after completing his course at the last officers' training camp at Fort Sheridan. He is now stationed at one of the southern cantonments and is attached to the infantry branch of the regulars.

The Weather for December 1917

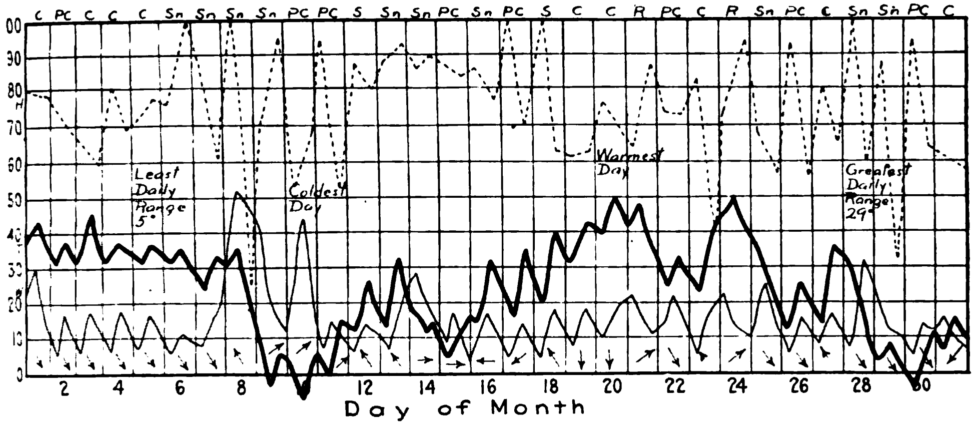
	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest temperature, degrees F.	46	48	50	52	66
Date of highest temperature	1	9	20	20	2
Lowest temperature, degrees F.	—13	—14	—5	—3	—4
Date of lowest temperature	30	30	10	10	10
Greatest daily range, degrees F.	28	35	29	28	25
Date of greatest daily range	29	8	28	24	24
Least daily range, degrees F.	7	7	5	6	8
Date of least daily range	20	19	5	2	14
Normal temp. for month, degrees F.	25	24	24	22.4	26.8
Normal mean temp. for month, deg. F.	34.4	31.6	34.7	29.3	35.5
Total rainfall, in.	3.70	2.56	1.19	0.88	0.78
Total snowfall, in.	11.7	7	11.8	9	7.5
Normal precipitation, this month, in.	3.45	3.41	2.73	2.08	2.23
Total wind movement, miles	14521	9148	8195	9499	9494
Average hourly wind velocity, miles	19.5	12.3	11	12.8	12.8
Prevailing direction of wind	N.W.	N.W.	N.W.	N.W.	S.
Number of clear days	10	6	2	5	5
Number of partly cloudy days	7	8	10	12	1
Number of cloudy days	14	17	19	14	15
Number of days on which rain fell	9	3	3	1	5
Number of days on which snow fell	7	9	10	12	9
Snow on ground at end of month, in.	1.7	0.3	1.8	1	1.3



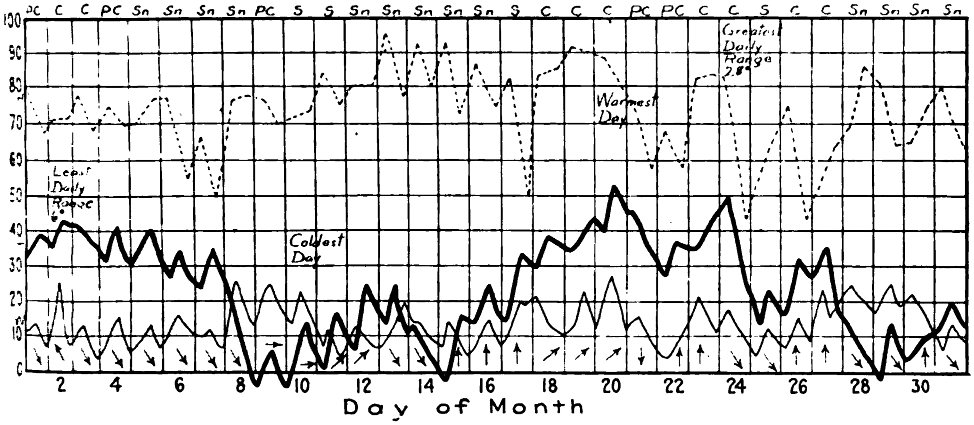
RECORD OF THE WEATHER IN NEW YORK FOR DECEMBER, 1917.
(Hourly Observations of the Relative Humidity are Plotted on this Chart.)



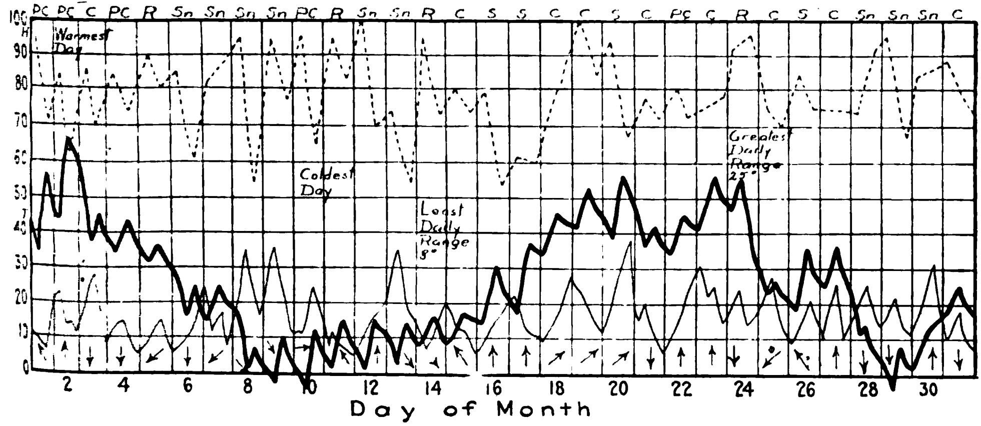
RECORD OF THE WEATHER IN BOSTON FOR DECEMBER, 1917.



RECORD OF THE WEATHER IN PITTSBURGH FOR DECEMBER, 1917.



RECORD OF THE WEATHER IN CHICAGO FOR DECEMBER, 1917.



RECORD OF THE WEATHER IN ST. LOUIS FOR DECEMBER, 1917.

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.

Heavy lines indicate temperature in degrees F.

Light lines indicate wind in miles per hour.

Broken lines indicate relative humidity in percentage from readings taken at 8 A. M. and 8 P. M.

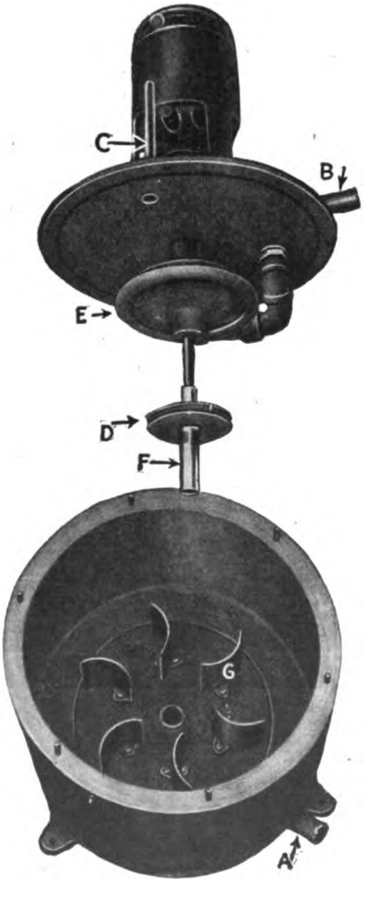
S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.

Arrows fly with prevailing direction of wind.

New Type of Vacuum Pump

It has long been the aim of vacuum pump manufacturers to get as far away as possible from complicated features of design and to eliminate all gears, valves, plungers, pulleys, belts, separating mechanism or intermediate connections that were not essential. A step further in this direction has been taken by the Chicago Pump Co., Chicago, Ill., in its design of the Chicago turbine vacuum pump which the company has recently placed on the market.

As indicated by the accompanying illustration the vacuum pumping outfit consists of a cast-iron receiver with two impellers on one shaft, directly connected and driven by one electric motor. One impeller draws the air and water from the heating system, while the second impeller discharges the condensation water directly into the boiler. There is no other mechanism in the equipment.



NEW TYPE OF CHICAGO VACUUM PUMP.

The same equipment is used for air line vacuum heating where the air is withdrawn from the heating system. The air line pump is similar in construction to the return line vacuum pump, with the exception that it embodies only one air impeller, as it does not have to discharge water into the boiler. A difficulty sometimes experienced with air line pumps is that an unavoidable slug of water coming from heating system may stall the air line pump, but since the Chicago turbine air line pump depends upon water to help it maintain a vacuum, no amount of water interferes with its operation. If too much water returns from the heating system, it overflows through an overflow provided for that purpose.

When in operation on a return-line system, the air impeller D revolves in the center of the water brakes G which are stationary. The centrifugal force imparted to the water by the air impeller and the constant breaking up of the water by the water brakes, creates a suction or vacuum in the center of the air impeller, which in turn creates a vacuum on the return line A, through suction inlet F, which connects to return line A. The air and water drawn through this impeller accumulate in the receiver and, when the water level reaches the centrifugal water pump E, which is located a few inches above the air impeller, it is discharged into the boiler through discharge pipe B. The air is exhausted to atmosphere through vent C.

The ratio of air to water of this type of pump is 8 to 1 at 8 in. of vacuum, while, at a vacuum of 3 in., it is 25 to 1. Therefore, at an average vacuum of 5 in. and when pumping the rated or required amount of water, this pump will have a ratio of about 16 cu. ft. of air to 1 cu. ft. of water.

The manufacturer emphasizes the fact that this pump separates the air and water in the receiver, so that no other air eliminating or separating tanks are required, the air being exhausted to the atmosphere and the water only pumped against actual boiler pressure.

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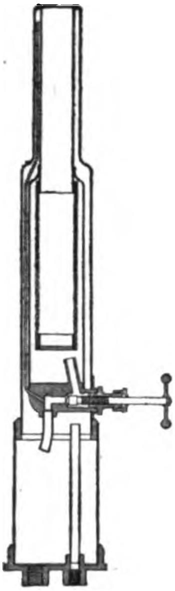
Demand for Double-Pipe Type of Air Moisteners.

The increasingly persistent demand for air moisteners that may be used with some of the various types of steam systems has made it necessary for The Air Moistener Co., of Chicago, Ill., to make its Nos. 2, 3 and 4 sizes of moisteners in the double-pipe type. This development has been in response to the demand for vacuum or molulated pressure systems. In both of these systems the branch feeding the radiator is often of such small size and so pitched that the condensation in it will not drain back to the riser, but is carried forward by the velocity of the flowing steam into the radiator, finding an exit by way of the return pipe, with the other condensation.

This condition, of course, does no harm, as far as the heating function is concerned, but if air moisteners were attached to branches under such conditions, condensation in the branch pipe and in the jacket surrounding the moistener, when the radiator was shut off, would be carried into the air moistener and discharged from it, together with the steam.



DOUBLE-PIPE TYPE OF STEAM AIR MOISTENER.

It was therefore necessary to provide the moistener with a drain of its own. To this end the makers now produce the small sizes of moisteners in the double-pipe type. As shown in the illustration, the moistener is provided with a separate supply and return which enter and lead from the bottom of the separator chamber, constituting the lower part of the moistener. Any condensation occurring in the inlet connection, or carried into it by the flowing steam, is deposited in this separator chamber, where it together with the condensation occurring in the jacket of the moistener, are led away by the return pipe, leaving only dry vapor to be discharged from the moistener.

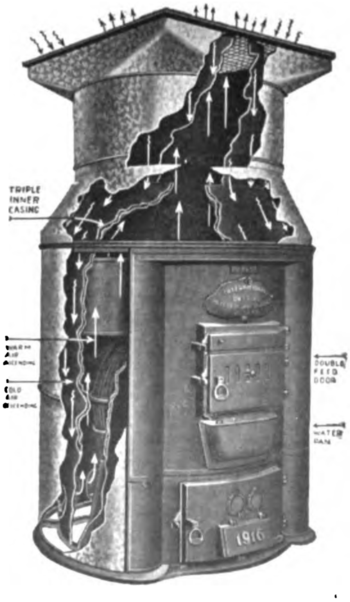
The return connection of the moistener leads to a special, small thermostatic trap which discharges the water of condensation to the return line of the heating system. Thus the air moistener is connected in the same manner as a radiator of the vacuum system.

With the vacuum system, the condensation is discharged to the return line of the heating system, which is below atmospheric pressure. With the modulated pressure systems the return is at or very near atmosphere, but the feed line somewhat above atmosphere, so there is always an incentive for the condensation to flow from the moistener to the return side of the system. Vacuum systems which are operated at atmosphere pressure, or below, on the feed side will not of course discharge moisture to the air. It is necessary to raise the pressure to one or two pounds, at the same time raising the pressure on the return line in proportion, or, in other words, decrease the vacuum. This is so that the pressure differential at the radiator traps will remain the same.

◆

Trade Literature.

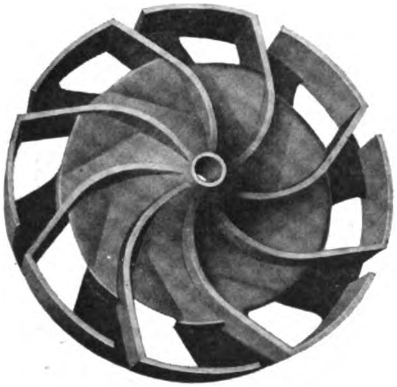
INTERNATIONAL ONE-PIPE HEATERS are featured in a catalogue issued by the International Heater Co., Utica, N. Y., and entirely devoted to this type of warm-air furnace. As its name implies, the heater uses only one large register which, however, is divided into two parts. The central por-



INTERNATIONAL ONE-PIPE HEATER

tion of the register carries up the heated air while the outer portion of the same register serves as an intake for the indoor air as it cools, thus providing a recirculating feature. As the space between the outer and inner casings is always filled with cool air returning to be heated, this type of furnace, it is claimed, will not heat the cellar. International one-pipe heaters are made in six sizes designed to warm from 4 to 14 ordinary-sized rooms. The special register furnished is finished in oxidized copper, of plain lattice design.

A NO-TANK VACUUM CLEANER is the way the Connersville centrifugal vacuum cleaner is designated in recent circular matter issued by the United Vacuum Appliance Co., Connersville, Ind. It is described as radically different in construction and operation from all other designs. It may be used not only for removing dust from dry surfaces, but also to suck up soap suds and dirty water from carpets and rugs after they have been scoured. It is also adapted to drying floors of cement, tile or linoleum, after they have been scrubbed. This scrubbing is often accomplished by the use of an electric rotary scrubbing brush. Nothing but clean air passes through the vacuum pump, as all the refuse is continuously discharged into the sewer by the flutted rotor, under no pressure. This centrifugal separation of the air and refuse, together with their automatic discharge, is accomplished without tanks, box, screens, or buckets. The rotor shown in the accompanying illustration is responsible for the separation of the dirt and air.



ROTOR USED WITH NO-TANK VACUUM CLEANER.

HYDRO GAS METERS, made by the Bacharach Industrial Instrument Co., Pittsburgh, Pa., are described in a new catalogue (E), issued by this company. First is given a review of the various methods employed for measuring gases, such as impact and Pitot tubes, orifices, nozzles, venturi tubes, etc., cuts being used to illustrate these methods. It is pointed out that in each of these devices, the differential pressure is the quantity to be measured, and then follows a description of the Hydro instrument which measures and records this differential pressure. By varying the proportions of the instrument, any desired magnification of the differential pressure can be obtained.

Applications of the Hydro volume meter to blast furnaces, producer plants, etc., are given, as well as measuring air for mine and building ventilation. The instrument is also made portable for use of the testing engineer and the efficiency expert.

HOW ANYONE CAN MAKE A JOINTLESS, GAS-TIGHT FURNACE LINING is told in a 16-page illustrated folder received from the Betson Plastic Fire Brick Co., Rome, N. Y. The folder shows how the "plastic fire brick" made by this company is used in forming one-piece linings for steam boiler furnaces. The old lining of fire-bricks or blocks is first removed and the plastic material is then placed in the form of chunks, consolidated with a mallet and smoothed with a trowel, occupying the same thickness as the old lining. The special mechanical process used in the preparation of this material is said to eliminate expansion and contraction with temperature changes. After the material has been dried and set by a slow fire for four or five hours, the furnace can be put into full service. No molds or special forms are used. The same material is used for forming baffles in water-tube boilers.

INDUSTRIAL ELECTRIC HEATING APPARATUS, carrying the entire product in this line of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., is presented to the trade in a new catalogue (8-E.). The line includes steel-clad heaters for many industrial processs, immersion-type water heaters, etc. Data are given for calculating the proper amount of heating to provide for water and for the heating of buildings. Westinghouse electric heaters, which are of the ribbon type, are described and also the company's system of thermostatic control. The catalogue should prove of value to any man whose work includes the application of heat at moderate temperatures for industrial purposes.

SUPPLY AND EXHAUST OUTLETS.

While there are many different methods of making flue connections to supply and exhaust outlets, the simplest satisfactory connections are shown in Figs. 1 and 2.

In Fig. 1 is illustrated an up-feed supply system outlet in which the vertical flue is carried a slight distance above the top of the outlet in order to form an air cushion and to help equalize the air flow across the register face. This distance—which is usually made 8 in. to 12 in.—does not absolutely equalize the air flow but tends to prevent such a large quantity of air shooting out through the top third of the register as would be the case if a plain elbow were used.

The volume damper is an ordinary wing damper one end of which is attached to a wire held by the set screw. It is necessary to have the register face either hinged or to set the volume dampers before the installation of the registers. Many engineers prefer their volume dampers set at other points in the duct system to avoid this difficulty, but it must be admitted that an outlet can be set more quickly from anemometer readings when the damper is at the outlet than when it is off in some other part of the building.

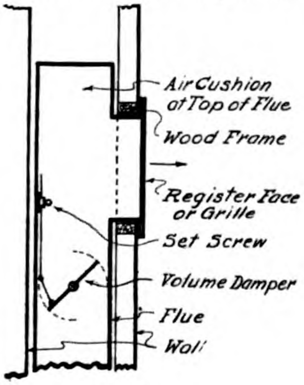


FIG. 1

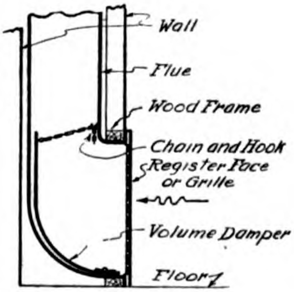


FIG. 2.

Fig. 2 illustrates a similar outlet for an up-feed exhaust system with a volume damper consisting of a piece of curved sheet metal riveted to the flue at the bottom and hooked to the proper position at the top by means of the chain and hook shown. The spring of the metal will hold this damper tightly in its proper place after being adjusted. To operate this damper a hinged or removable register must be used and for this reason some engineers prefer controlling air in the flue from a damper located in the horizontal duct connecting to the top of the flue.

In all cases it has been found advantageous to have the wood frame made around the flue outlet in the shop; this protects the outlet during shipping, handling and erection, keeping it in proper shape and preventing bending and dents. After the flues are erected the wooden frames have wall ties nailed to them and are walled in; the furring strips are run around the edge and the wall plastered, after which the registers or grilles are mounted by attaching them to the metal, or by screwing through the furring into the solid wood of frame.

REVERSING DAMPERS.

In many buildings it is considered desirable to put the warm air in at the upper openings during the winter, drawing the cold air out of the lower exhaust openings at the floor, while in summer it is preferred to draw the hot air at the ceiling off through the upper openings and putting the cold air in through the lower openings. In other cases it may be desirable to use upward ventilation (supply openings low and exhaust openings high) whenever cigar smoke is to be handled, and downward ventilation (supply openings high and exhaust openings low) at all other times.

In the ordinary duct system such a reversal is impossible, but in cases where the supply and exhaust fans are set close together, or where the main supply and exhaust ducts run near each other, it is possible to provide for such conditions by the proper arrangement of one or more dampers.

The single reversing damper is shown in Fig. 1, the duct E being connected to the suction opening of the exhaust fan, the duct S to the discharge opening of the supply fan, the duct U to the upper openings in the building and the duct L to the lower openings in the building. It is self-evident that the turning of the damper from the position shown in full lines to the position shown in dotted lines will reverse the flow of air in both the ducts U and L. The ducts coming into such a damper must all be of the same size and dimensions, the height H of the damper being the same as the height of the duct. The radius of the damper casing r is equal to the width of the duct D, plus a few inches (to allow for the construction in the middle of the damper). The damper radius R is equal to 2r or twice that of the casing.

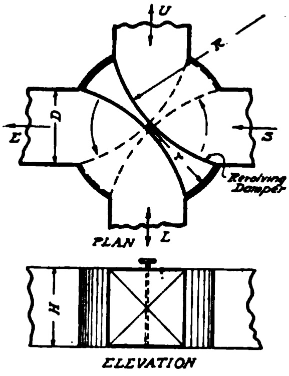


FIG. 1.

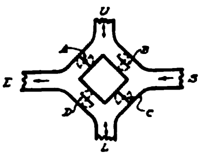


FIG. 2.

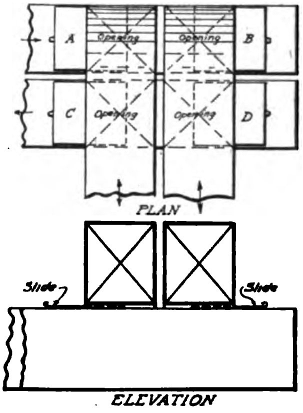


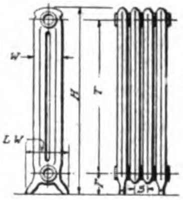
FIG. 3.

A second method, where the ducts are not on the same level, is shown in Fig. 2. Here the opening of slides A and D closing B and C or the opening B and C and the closing of A and D will reverse the flow in the ducts U and L.

A third method is shown in Fig. 3, where the opening of dampers A and C and the closing of B and D will reverse the flow in ducts U and L from what it would be with B and D open and A and C closed.

AMERICAN RADIATOR COMPANY'S ROCOCO TWO-COLUMN RADIATORS FOR STEAM AND WATER

No. of Sections	* Length 2½ in. per Sec.	Heating Surface — Square Feet					
		45-in. Height 5 sq. ft. per Sec.	38-in. Height 4 sq. ft. per Sec.	32-in. Height 3⅓ sq. ft. per Sec.	26-in. Height 2⅔ sq. ft. per Sec.	23-in. Height 2⅓ sq. ft. per Sec.	20-in. Height 2 sq. ft. per Sec.
2	5	10	8	6⅔	5⅓	4⅔	4
3	7½	15	12	10	8	7	6
4	10	20	16	13⅓	10⅔	9⅓	8
5	12½	25	20	16⅔	13⅓	11⅔	10
6	15	30	24	20	16	14	12
7	17½	35	28	23⅓	18⅔	16⅓	14
8	20	40	32	26⅔	21⅓	18⅔	16
9	22½	45	36	30	24	21	18
10	25	50	40	33⅓	26⅔	23⅓	20
11	27½	55	44	36⅔	29⅓	25⅔	22
12	30	60	48	40	32	28	24
13	32½	65	52	43⅓	34⅔	30⅓	26
14	35	70	56	46⅔	37⅓	32⅔	28
15	37½	75	60	50	40	35	30
16	40	80	64	53⅓	42⅔	37⅓	32
17	42½	85	68	56⅔	45⅓	39⅔	34
18	45	90	72	60	48	42	36
19	47½	95	76	63⅓	50⅔	44⅓	38
20	50	100	80	66⅔	53⅓	46⅔	40
21	52½	105	84	70	56	49	42
22	55	110	88	73⅓	58⅔	51⅓	44
23	57½	115	92	76⅔	61⅓	53⅔	46
24	60	120	96	80	64	56	48
25	62½	125	100	83⅓	66⅔	58⅓	50
26	65	130	104	86⅔	69⅓	60⅔	52
27	67½	135	108	90	72	63	54
28	70	140	112	93⅓	74⅔	65⅓	56
29	72½	145	116	96⅔	77⅓	67⅔	58
30	75	150	120	100	80	70	60
31	77½	155	124	103⅓	82⅔	72⅓	62
32	80	160	128	106⅔	85⅓	74⅔	64



Connections: **Water**—Extra-heavy right and left-threaded nipples top and bottom. **Steam**—Extra-heavy right-threaded nipples at bottom only and with right and left-threaded nipples at bottom only.

Low Drip Hubs: **One-Pipe Steam**—on supply leg-section; **Two-Pipe Steam**—on return leg-section.

* Add ½ in. to length for each bushing.

DIMENSIONS

H = Total overall height.
T = C. to C. of tappings.
F = Floor to center of bottom tapping.
W = Width of Radiator—7⅜ in.
LW = Width of Radiator Legs—8 3/16 in.
S = Width of Radiator Sections—*i.e.*, c. to c. of sections or 2½ in.

Nominal Height of Radiator	45-in.	38-in.	32-in.	26-in.	23-in.	20-in.
H	45 25/64	37 45/64	31 53/64	26 5/64	23 11/64	20 1/4
T	38 25/32	31 3/32	25 13/32	19 15/32	16 9/16	13 41/64

Note: For legless radiators deduct 3 in. from H.
For high legs add 2 in. and for extra high 4 in. to H. and F.
On 45-in. radiators high legs and extra high legs are special.

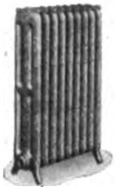
TAPPING DATA

All radiators are tapped 2 in. and bushed as follows:

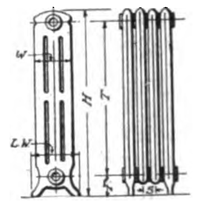
SYSTEM	Size of Radiator, Square Feet	Supply In. Diam.	F In.	Return In. Diam.	F In.
Steam, one-pipe	Up to 24 inc.	1	4	..	..
	Over 24 up to 60 inc.	1¼	4	..	..
	Over 60 up to 100 inc.	1½	4	..	..
	Over 100	2	4	..	..
Steam, two-pipe	Up to 48 inc.	1	4½	¾	4
	Over 48 up to 96 inc.	1¼	4½	1	4
	Over 96	1½	4½	1¼	4
Water	Up to 40 inc.	1	4	1	4
	Over 40 up to 72 inc.	1¼	4	1¼	4
	Over 72	1¼	4	1½	4

Air valve tappings are ⅛ in.
Vapor tappings, top and bottom, opposite ends ¼ in. supply and ½ in. return.
All tappings with right-hand threads unless otherwise ordered.

AMERICAN RADIATOR COMPANY'S ROCOCO THREE-COLUMN RADIATORS FOR STEAM AND WATER



No. of Sections	* Length 2½ in. per Sec.	Heating Surface — Square Feet 45-in. Height 6 sq. ft per Sec	38-in Height 5 sq. ft per Sec	32 in Height 4½ sq. ft per Sec	26-in Height 3¾ sq. ft. per Sec.	22-in. Height 3 sq. ft. per Sec	18-in Height 2¼ sq. ft per Sec
2	5	12	10	9	7½	6	4½
3	7½	18	15	13½	11¼	9	6¾
4	10	24	20	18	15	12	9
5	12½	30	25	22½	18¾	15	11¼
6	15	36	30	27	22½	18	13½
7	17½	42	35	31½	26¼	21	15¾
8	20	48	40	36	30	24	18
9	22½	54	45	40½	33¾	27	20¼
10	25	60	50	45	37½	30	22½
11	27½	66	55	49½	41¼	33	24¾
12	30	72	60	54	45	36	27
13	32½	78	65	58½	48¾	39	29¼
14	35	84	70	63	52½	42	31½
15	37½	90	75	67½	56¼	45	33¾
16	40	96	80	72	60	48	36
17	42½	102	85	76½	63¾	51	38¼
18	45	108	90	81	67½	54	40½
19	47½	114	95	85½	71¼	57	42¾
20	50	120	100	90	75	60	45
21	52½	126	105	94½	78¾	63	47¼
22	55	132	110	99	82½	66	49½
23	57½	138	115	103½	86¼	69	51¾
24	60	144	120	108	90	72	54
25	62½	150	125	112½	93¾	75	56¼
26	65	156	130	117	97½	78	58½
27	67½	162	135	121½	101¼	81	60¾
28	70	168	140	126	105	84	63
29	72½	174	145	130½	108¾	87	65¼
30	75	180	150	135	112½	90	67½
31	77½	186	155	139½	116¼	93	69¾
32	80	192	160	144	120	96	72



Connections: **WATER**—extra-heavy right and left-threaded nipples at top and bottom. **STEAM**—with extra-heavy right-threaded nipples at bottom only and with right and left-threaded nipples at bottom only.

Low Drip Hubs: **ONE-PIPE STEAM**—on supply leg-section; **TWO-PIPE STEAM**—on return leg-section.

* Add ½ in. to length for each bushing.

DIMENSIONS

H = Total overall height.
T = C. to C. of tappings on water radiators.
F = Floor to center of bottom tapping.
W = Width of radiator—9 in.
LW = Width of radiator legs—9⅞ in.
S = Width of Radiator Sections—*i.e.*, c. to c. of sections or 2½ in.

Nominal Height of Radiator	45-in.	38-in.	32-in.	26-in.	22-in.	18-in.
H	45 15/16	38 11/32	32 11/32	26 19/32	22 11/32	18 5/16
T	38 25/32	31 3/32	25 13/64	19 15/32	15 7/32	11 3/16

Note: For legless radiators deduct 3 in. from H.
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On 45 in. radiators high legs and extra high legs are special.

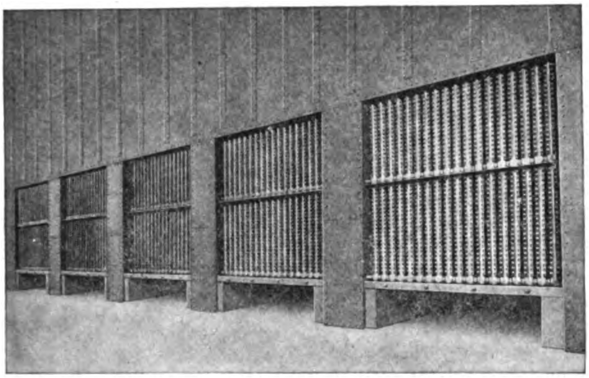
TAPPING DATA

All radiators are tapped 2 in. and bushed as follows:

SYSTEM	Size of Radiator, Square Feet	Supply In. Diam.	F In.	Return In. Diam.	F In.
Steam, one-pipe	Up to 24 inc.	1	4	..	..
	Over 24 up to 60 inc.	1¼	4	..	..
	Over 60 up to 100 inc.	1½	4	..	..
	Over 100	2	4	..	..
Steam, two-pipe	Up to 48 inc.	1	4½	¾	4
	Over 48 up to 96 inc.	1¼	4½	1	4
	Over 96	1½	4½	1¼	4
Water	Up to 40 inc.	1	4	1	4
	Over 40 up to 72 inc.	1¼	4	1¼	4
	Over 72	1½	4	1½	4

Air valve tappings are ⅛ in.
Vapor tappings, top and bottom, opposite ends ¼ in. supply and ½ in. return.
All tappings with right-hand threads unless otherwise ordered.

Heating and ventilating large buildings



Large banks of VENTO Heaters supplying warmed fresh air in a Kansas City school building. Shows the great range of sizes possible with VENTO Heaters

All buildings, such as factories, schools, universites, colleges, churches, stores, banks, hospitals, hotels, theatres, libraries, and museums requiring large volumes of air freshly warmed by steam, vapor or water are efficiently served by

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Send for our complete manual of engineering information containing tables of data on temperatures, condensations, ratings, free areas with charts on best methods of connection, etc.

Engineers and heating contractors should use this book for its valuable information.

AMERICAN RADIATOR COMPANY

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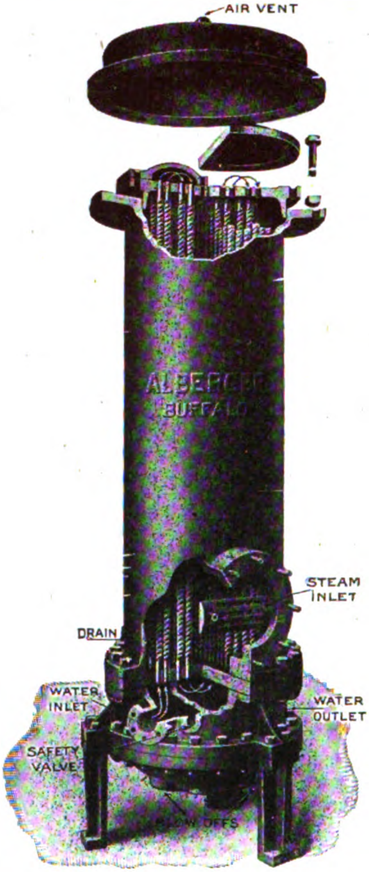

Cast-Iron and Copper Do Not Corrode

In selecting materials for manufacturing the

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the aim is to choose those which are subject to the least deterioration from use, with the result that only the best grades of cast-iron and copper are used. Steel and even charcoal iron are not used. The tubes are of pure copper.

All water and steam connections are on the body of the shell, providing easy access to the heating surface.

"The closed Heater without the usual Closed Heater Troubles"

Our Manual on "Heating Water with Steam" gives interesting details

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TRADE AND MISCELLANEOUS NOTES

Miscellaneous Notes.

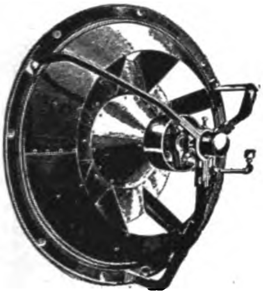
Chicago, Ill.—An order has been issued by the Cook County Fuel Administration Committee which states that "as a conservation measure for the purpose of relieving the present coal shortage and indirectly to assist in relieving the congested condition of the railroads, all users in Cook County, Ill., of fuel for heating purposes in hotels, office buildings, stores, shops, theatres, factories, apartment buildings, flats, residences, and all other structures, are hereby directed to maintain in all such buildings, structures, and places, a temperature of not to exceed seventy degrees, except on specific orders from a physician where, in special instances, it is necessary to maintain a higher temperature." The order, unless withdrawn, continues in effect until April 1, 1918. Placards announcing the fuel administration committee's order have been distributed by the Building Managers' Association, in which the following additional rules are given: Turn off radiators in all rooms not in actual use; ventilate properly but do not waste heat—waste of heat is waste of fuel; turn out lights not in use; do not waste hot water—every gallon wasted wastes so much fuel.

Bozeman, Mont.—A central heating plant for the State Tuberculosis Sanitorium at Galena, Mont., is under consideration. Fred F. Wilson, of Bozeman, is the architect.

Albert W. Clegg, of F. A. Clegg & Co., Louisville, Ky., heating and ventilating contractors, was married December 24, to Miss Mary Seiler, of Louisville. Mr. Clegg is now at Camp Joseph H. Johnson, Jacksonville, Fla., in training for a commission in the Quartermaster's Reserve Corps.

Frank B. Howell, assistant general manager of sales of the American Radiator Company, with headquarters in Buffalo, is recuperating from an attack of pneumonia.

A. C. Edgar, for many years manager of



DUPLEX CONE FAN
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HOWARD & MORSE
45 FULTON ST., N. Y.
Ventilating Engineers and Contractors
MANUFACTURERS OF
BLACKMAN and DUPLEX CONE FANS

which are installed by us complete with **Motors, Duct Work** and **Wiring.**

Aligning, Rigging and **Hoisting** done, with labor thoroughly qualified from long experience.

We make a specialty of **Kitchen Exhaust** work. Prominent buildings, hospitals, theatres, and private residences are among our many and recent installations.

The **Duplex Cone** Fans are semi-conoidal fans, made especially to operate against pressure in duct systems.

The **Blackman** Fans are used for fresh air delivery and in duct systems, when no great pressure is involved.

You can have the advantage of our experience.

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BLACKMAN FAN
Direct Connected to Motor

the boiler department of the Abram Cox Stove Co., Philadelphia, Pa., is acting as technical expert for the United States Shipping Board Emergency Fleet Corporation, with headquarters in the Commercial Trust Building, Philadelphia. Mr. Edgar will divide his time between the Hog Island, Bristol and Newark shipbuilding plants.

National Pipe & Supplies Association will hold its ninth annual convention in Cleveland, O., May 13 and 14, 1918. Headquarters will be at the Hollenden Hotel. On the three days following this convention, May 15-17, a triple convention will be held of the National Supply & Machinery Dealers' Association, the Southern Supply & Machinery Dealers' Association and the American Supply & Machinery Manufacturers' Association.

Professor John R. Allen, of the University of Minnesota, was in Washington recently attending a conference in connection with his work in the Signal Service Department of the army.

Fort Wayne, Ind.—The expansion of the General Electric Company's plant and the increased demands upon the steam and water systems has created the need for more attention to that portion of the plant. A new office is the result, O. C. Fink having been appointed supervisor of the steam and water system. His duties will be to see that the facilities in his department are utilized to good advantage and that no damage results from want of heat, such as freezing of pipes and too low temperatures in the offices and shops where men and women work.

Central Supply Association will hold its regular winter meeting in Chicago, February 20, at the Auditorium Hotel. An address will be given by an expert on "Depreciation, Co-Insurance and Tax Reports."

◆

Manufacturers' Notes.

D. T. Williams Valve Co., Cincinnati, O., has purchased the plant of the Queen City Brass & Iron Co., of that city, which will be used to give additional capacity for the D. T. Williams Valve Co. The deal, it is stated, involved an amount approximating $300,000. The capital stock of the D. T. Williams Valve Company will be increased from $175,000 to $750,000, all of which will be absorbed by the present stockholders.

Moline Heat, Moline, Ill., announces that

Watch for Our Announcement

in the March Issue
of our

New
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Multivane Wheel

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L. J. Wing Mfg. Co.
352 W. 13th Street
New York City

Established 1879
McCormick Bldg.
CHICAGO, ILL.

Karstens Engineering Sales Co.
5 Jefferson Ave.
Detroit, Mich.

George P. Smith, for the past four years manager of the heating department of the Mine & Smelter Supply Co., Salt Lake City, Utah, has been appointed sales representative for Moline Heat, covering Utah, part of Nevada, Wyoming and Idaho. Mr. Smith will make his headquarters at 202 Dooly Building, Salt Lake City.

Lavigne Mfg. Co., Detroit, Mich., announces that the company's name has been changed to the Commonwealth Brass Corporation. The management has long held the idea that the former name was not truly representative of the activities of the company and therefore has selected a title more closely identified with the brass industry. There will be no change in the description, quality or type of goods produced by the corporation under its new name and the personnel remains the same as before, namley: President, P. D. Dwight; vice-president and general manager, N. A. Henwood; secretary and treasurer, Carl L. Brumme; superintendent, C. S. Kellum. It is further announced that J. P. Lavigne, at one time connected with the Lavigne Mfg. Co., is not associated with the Commonwealth Brass Corporation.

Bishop-Babcock-Becker Co., Cleveland, O., has secured control of the Consolidated Engineering Co., Chicago, Ill., manufacturer of the Van Auken system of vacuum heating, Kinealy air washers and the Thermograde modulation system of heating, as well as of the Massachusetts fans, with plants in Chicago and Watertown, Mass. The Bishop-Babcock-Becker Company is preparing plans for a new manufacturing plant to be built on a site the company has purchased at Bliss Road and the Nickel Plate Railroad, near Cleveland.

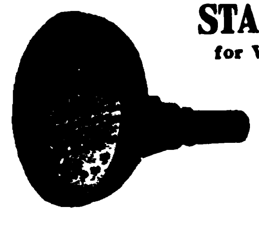
Crane Co., Chicago, Ill., distributed approximately $1,200,000 to its employees at Christmas time, being 10% of the earnings of each employee. About 12,000 employees shared in this distribution. The company also presented to each employee a book of war savings stamps partially filled.

Union Radiator Co., Johnstown, Pa., announces that William Speakman, formerly manager of the company's Pittsburgh branch, has been placed in charge of the company's Philadelphia office, at 106 North 17th Street.

Ohio Blower Co., Cleveland O., held a convention of its salesmen at the Winton Hotel, Cleveland, January 3-5 last.

Sprague Electric Works, New York, has

CHICAGO TURBINE VACUUM PUMPS
For Maintaining a Constant Vacuum and Returning Condensation Directly to Boiler
SIMPLE - DURABLE - POSITIVE
One air and one water impeller are mounted on one shaft in cast-iron receiver and driven by one motor. Air and water return at bottom of receiver, the air is exhausted to atmosphere, and water discharged to boiler. The receiver has a low water level.
AIR LINE VACUUM PUMPS
FOR USE ON AIR LINE HEATING SYSTEMS
are even simpler than Vacuum Pump. Take up little space. Run quietly and will not be affected by any amount of water. We can make quick delivery.
CHICAGO PUMP CO., 900 W. Lake St., Chicago, Ill.
Manufacturers of BILGE, CONDENSATION, MULTI-STAGE, TURBINE, HOUSE, CIRCULATING and BOILER FEED PUMPS and SEWAGE EJECTORS

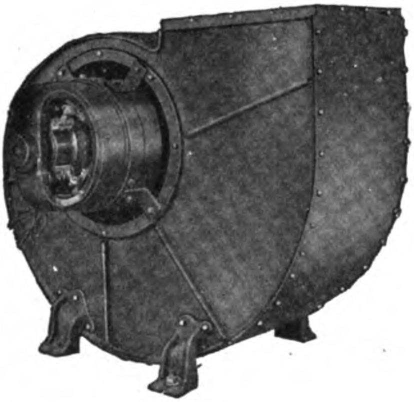


STANDARD THERMOMETERS - Indicating and Recording
for VACUUM, STEAM and HOT WATER SYSTEMS, BAKE OVENS and COLD STORAGE PLANTS. SEVEN models of RECORDING and EIGHT of INDICATING Thermometers. All Accurate, Durable and Legible.
Backed by thirty years of Thermometer manufacturing.
They are practically indestructible, are sensitive to changing temperatures and are very easily installed. Supplied with horizontal or vertical extension and standard pipe thread.
Ask for catalog No. 100-107 and trade prices.
STANDARD THERMOMETER COMPANY, 65 Shirley St., Boston, Mass.

appointed Frank W. Hall as commercial manager of the company. With the exception of a short period, Mr. Hall has been connected with the Sprague Electric Works continuously for 22 years in various engineering and sales capacities, and for three years prior to his present appointment occupied the position of sales manager. D. C. Durland, former executive head of the Sprague Electric Works, has resigned to accept the presidency of the Mitchell Motor Co., Inc.

Skinner Bros. Mfg. Co., St. Louis, Mo., manufacturers of the Baetz patent air heaters announces that its recent orders include 13 heaters for the Newport News Shipbuilding & Dry Dock Co., 12 heaters for the American Car & Foundry Co., for its shops in Depew, near Buffalo; 11 heaters for the Berger Mfg. Co., Canton, O.; and 10 heaters for the Holt Mfg. Co., Peoria, Ill.

Lennox Furnace Co., Marshalltown, Ia., has increased its capital common stock from $250,000 to $400,000. The company already has an authorized issue of $100,000 7% preferred stock.



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in a Blast Heating System
is
AT THE BLOWER

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You can be sure that it will be reliable

Motor and Blower

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BY US and
COVERED BY
ONE GUARANTEE

The one-name plate feature is your protection

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158 Whiting St., CHICAGO
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THE HEATING AND VENTILATING MAGAZINE

Cooperstown, N. Y. MARCH, 1918 1123 Broadway, New York

Meeting the High Cost of Heating and Ventilating Apparatus

With Suggestions for Proposed System to Reduce Cost of Installation and Operation.

What can be done to reduce the cost of heating and ventilating installations whose constant and continued advance in price constitutes a real menace to those interested in this line of work? The menace is dangerous and makes itself visible in two quite distinct ways. In the first place the increase in the cost of all building work, both on the material and labor end, tends to make the scrutiny of every item much more close and more critical, creating at the same time a temptation greater than ever before to economize on the equipment of the building in order to allow a greater investment in the structure or its decoration.

The second way in which the menace can be clearly perceived is in the rise of the labor and material cost for heating and ventilating work itself, tending toward the omission of desirable and even necessary ventilation, while the heating end is regarded as a necessary (but expensive) evil.

What, then, can be done to reduce cost without a reduction of service supplied or the loss of permanency in construction? The following suggestions are offered as serving to point the way toward maximum of economy in installations.

PIPE COILS INSTEAD OF RADIATORS.

(*a*) The use of pipe coils in place of radiators wherever possible for the reason that a pipe coil costs less per square foot than a radiator, distributes its heat over a greater area and can be used in almost every position that would accommodate a radiator. While it is true that pipe coils would not look well in a residence or fine office building and are not here advocated for such work, in almost every

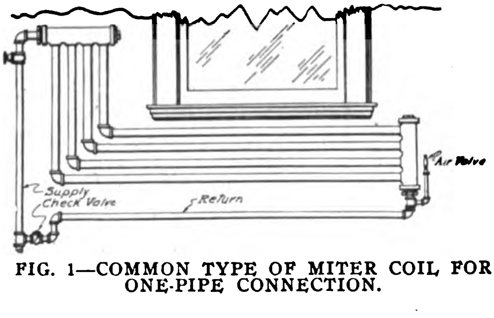


FIG. 1—COMMON TYPE OF MITER COIL FOR ONE-PIPE CONNECTION.

other building they can be substituted with advantage especially if made of the return-bend or miter-coil pattern. There is no logical reason, in these times at any rate, to object to pipe coils in any basement or in schools, garages, halls, auditoriums, industrial buildings, railroad stations, fire houses, police stations, comfort stations, telephone exchanges, etc.

Owing to the efficiency per square foot of a pipe coil being well over 300 B.T.U. while cast-iron radiation runs only 250, or even less, it is possible to reduce the radiation by over 17% where pipe coils are used.

Fig. 1 shows a common type of miter coil installed for one-pipe connection, the coil practically being piped up two-pipe, but with the return connected to the one-pipe riser through the check at the bottom of the drop, the drop above the check being made high enough to furnish the head of water necessary to operate the flap of the check.

AVOID CEILING RADIATION.

(*b*) As the radiation is more efficient when installed at or near the floor, avoid the use of ceiling coils and ceiling radiators. While the placing of radiation on the ceiling will not increase or decrease the mains or boiler load, it will increase the cost of radiation (approximately 10%, or over, additional surface is required for such installation).

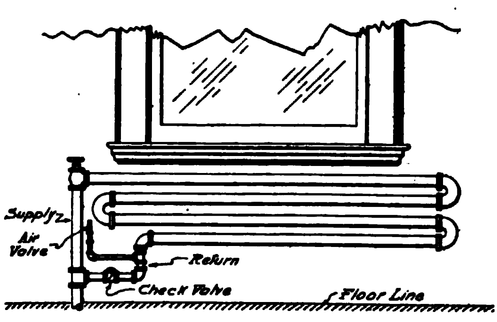


FIG. 2—RETURN-BEND COIL FOR USE IN CRAMPED QUARTERS.

In order to get coils under windows in cramped conditions the vertical end occurring on a miter coil in some cases would extend up in front of the glass. In such cases the return-bend coil, shown in Fig. 2, can be installed, the connections being arranged as shown in Fig. 1. For those objecting to the check valve a water-seal can be substituted, the only object being, of course, to prevent steam entering through the return connection and closing the air valve before the air has been completely expelled.

LARGER UNITS WITH FEWER VALVES.

(*c*) The use of larger units with fewer valves, never using more than two units in any room of ordinary size and valving up larger rooms so that one valve will control as many units as practicable. In this way the number of valves is reduced, a multitude of small runouts and connections are eliminated and much labor can be saved.

(*d*) The elimination, as far as possible, of radiator surface not working at full efficiency, such as recessed radiators, concealed radiators and surface under shelves, or where other hindrances prevent free circulation of air around and across the heating surface.

(*c*) The use of metal sash or wooden sash, with metal weather strips so as to reduce air leakage to a minimum. Also the addition of storm sash or double-glazed windows wherever possible. Under this heading might well be included the use of door checks, double vestibules, revolving doors or other devices to prevent cold drafts when the doors are opened.

(*f*) The omission of covering from the large steam mains in the basement or any other location where the surface of the main can be utilized as heating surface. This will not only reduce the cost of the covering but will at the same time permit a reduction of radiator surface proportionately.

(*g*) The running of all risers exposed and uncovered (instead of concealed in chases and covered, as is sometimes done) with a corresponding reduction in radiator surface in the rooms through which the risers pass.

USE OF ONE-PIPE IN PLACE OF TWO-PIPE SYSTEMS.

(*h*) The use of the one-pipe steam system either of the "circuit" or "Mills" variety, thereby avoiding duplication of risers, all the return valves on the radiators and much of the return piping.

(*i*) Avoid the use of indirect heating as far as possible, as it is uneconomical to operate and expensive to install. In spite of the fact that an indirect radiator has an efficiency running from 400 to 500 B.T.U. per square foot, the cost of duct work, etc., brings the indirect radiator (per room served) up a higher cost price than the common direct radiator.

Besides this an indirect radiator taking air from outside operates on an average incoming air temperature of 30° F. throughout the heating season, while a direct radiator probably averages 60° or possibly even higher owing to the fact that it does not use outside air.

(*j*) Avoid the use of galvanized-iron as much as possible; black iron painted with asphaltum on both sides will resist rust very nearly as well. Better yet is the substitution of a trunk line consisting of a concrete duct with branches of terra cotta pipe, connecting with vertical tile flues.

FLUES OF MASONRY IN PLACE OF SHEET METAL.

Fig. 3 shows how a heating or ventilating system can be arranged so as to avoid the use of sheet metal from the fan room to the register outlet, provided masonry flues are built from the basement up to the register outlet. Of course, for ordinary systems the vertical flues would be likely to be located on the inner walls' rather than on the outside walls as shown. This was so illustrated, however, to explain a later suggestion involving the warm (or tempered) air flues up the outside walls in order to secure certain advantages, as later pointed out.

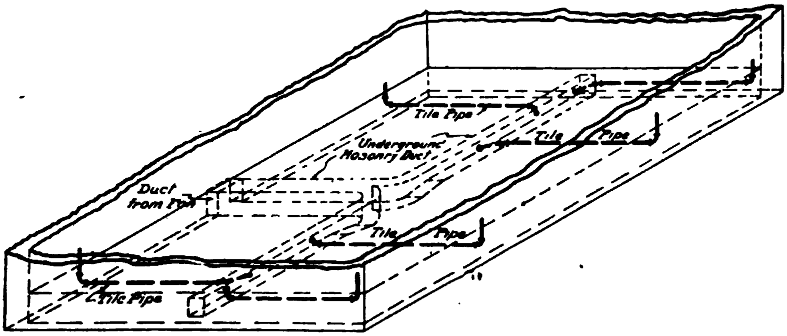


FIG. 3—HEATING SYSTEM ARRANGED TO AVOID USE OF SHEET METAL FROM FAN ROOM TO REGISTER OUTLET.

(*k*) The omission of covering from air flues, especially where the air is for ventilation only and is at or near the room temperature. The loss of heat from large ducts is not as great as might be supposed and if the smaller branches are covered but little drop in temperature will be experienced.

It can be demonstrated by calculating the heat radiation from a given size of sheet metal duct that the drop in temperature of the air in its passage amounts to but little until the small branches flowing at a low velocity are reached.

HIGHER AIR VELOCITIES IN THE DUCTS, REQUIRING LESS METAL.

(*l*) The use of higher velocities in the ducts, some engineers seldom going over 1,000 to 1,200 f.p.m. velocity even in the largest ducts while others run up to 2,000 f.p.m. or over. The area of the duct in the second case will be about 50% less due, of course, to the increased speed of the air.

In Fig. 4 is shown graphically the quantity of air passed in one minute by two ducts, one 12 in. x 12 in. at 1,000 ft. velocity and the other 0.7 ft. x 0.7 ft. at 2,000 ft. velocity. It can readily be seen that the volumes are identical. But the quantities of metal required are *not* the same. If a round duct at 2,000 ft. velocity has its metal assumed as unity, then a square duct carrying the same amount of air at the same velocity will require 1.13 times as much metal; a round duct at 1,000 velocity 1.38 times as much and a square duct at 1,000 velocity 1.59 times as much. These increases are represented graphically in the lower right-hand corner of Fig. 4.

A PROPOSED HEATING SYSTEM TO REDUCE COST OF INSTALLATION AND OPERATION.

The increasing effort to economize both on the installation cost and the coal consumption leads to the inquiry as to whether a radical change in the method of building ventilation would not do much to remedy the situation.

It is a well-known fact that any radiating surface will increase its heat transmission if a current of air blows across it. This fact has already been recognized in the figuring of indirect heaters whose efficiency is considered anywhere from 400 to 500 B.T.U. per square foot while similar radiation set out in the open in the room is only considered as giving 225 to 250 B.T.U. Also by the fact that a common electric fan set so as to blow against an ordinary radiator will heat the same room much more quickly than by the natural air movement without the fan.

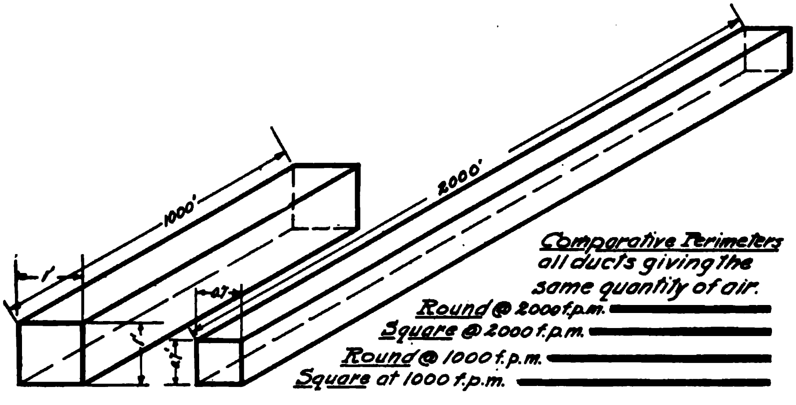


FIG. 4—INCREASES IN AMOUNT OF SHEET METAL REQUIRED FOR DUCTS, DEPENDING ON AIR VELOCITIES AND SHAPES.

Suppose in buildings where ventilation is provided—particularly in schools—that the fresh incoming air, instead of being put directly into the room, which is the customary procedure to employ, should be made to pass over the room radiators or secondary heaters, becoming heated to any temperature required. Then the room radiation would be working at 60% to 100% increased efficiency, while the air would be entering warm enough to heat the room as well as to ventilate it. On the other hand, if the room at any time should show a tendency to overheating, a cutting off of the secondary heater would result in holding down the temperature by the volume of cooler air coming in.

The advantages of such a system would consist chiefly of the following:

(1) Owing to its lower temperature the air could be efficiently handled in underground or uninsulated ducts and flues.

(2) The flues can be placed on the outside walls in the shape of pilasters, thus economizing on floor space by the omission of the concealing interior wall often called a "breathing wall."

(3) It is possible that the amount of direct radiation in the rooms may be reduced in most cases, owing to its increased efficiency, and certainly the hot blast heater surface may be cut nearly 25%.

(4) Heat is distributed all along the full width of the window sill, the warm air flowing up with a positive velocity (much greater than the natural gravity rise from a radiator) due to the air pressure from the supply fan being behind it.

(5) As a result of this more positive and more distributed upward flow the danger of cold down-drafts under the windows will be greatly lessened or even eliminated.

(6) There should be little or no heat

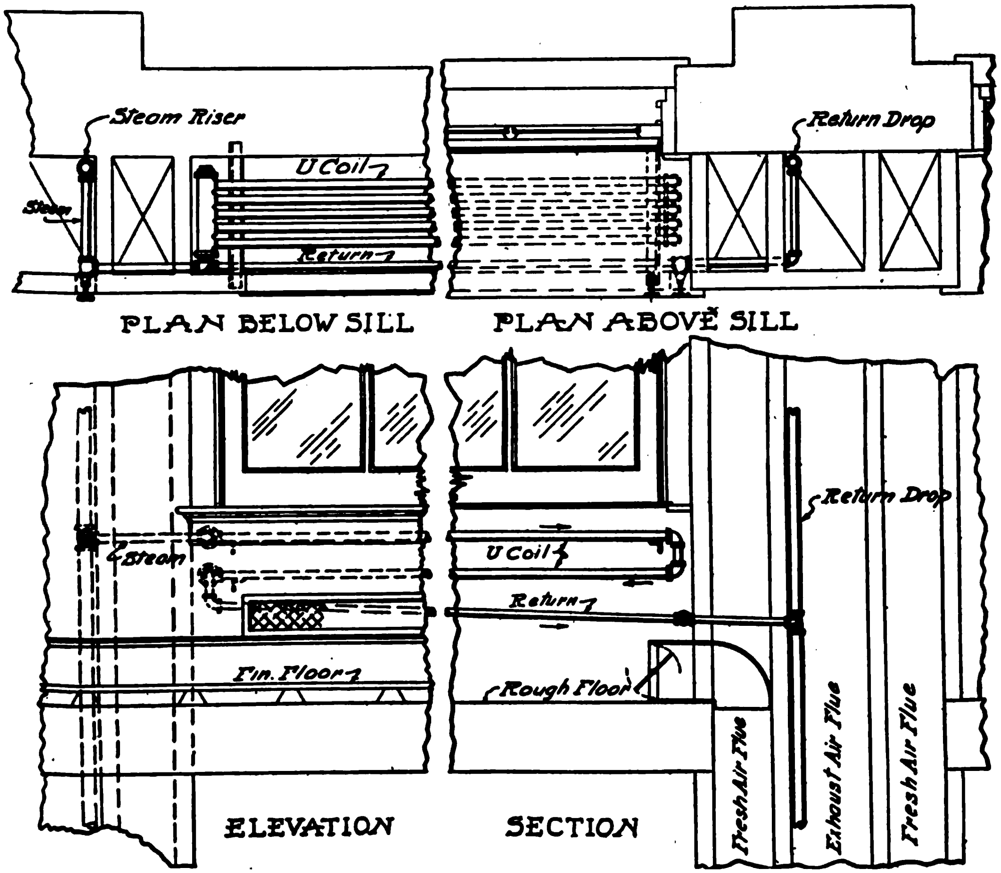


FIG. 5—PROPOSED HEATING SYSTEM WITH PIPE COILS PLACED IN PATH OF AIR SUPPLY.

loss in transmission of air between the fan and the room.

(7) The room can be cooled to any reasonable degree desired even when overcrowded and in mild weather.

DETAILS OF INSTALLATION.

The method of installation of such a system may be assumed as following somewhat along the scheme illustrated in Figs. 5 and 6 where a pipe coil is placed so as to occupy the space under a window seat formed between the fresh and exhaust air flues. For heating when the ventilating system is not in operation the damper in the fresh air flue can be closed and the long register over the base board can be opened so as to maintain a gravity circulation of air in the room.

The ordinary school room has radiator surface running from 40 sq. ft. to 130 sq. ft., according to size, exposure, and amount of glass surface. The amount of fresh air is usually 1,200 c.f.m. for a 40-pupil room and 1,500 c.f.m. for a 50-pupil room. If this air is delivered to the room coils at 60° it must be raised 10° before it can do any heating in the room—assuming the room temperature is to be kept at the usual 70° mark.

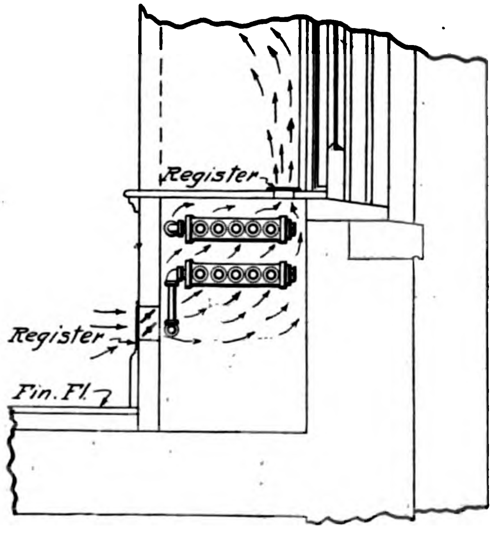


FIG. 6—ARRANGEMENT FOR MAINTAINING AIR CIRCULATION OVER COIL WHEN VENTILATING SYSTEM IS NOT IN OPERATION.

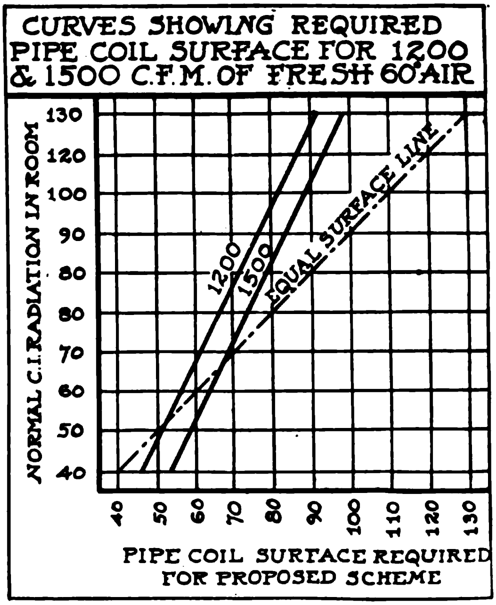


FIG. 7—CHART FOR FIGURING PIPE COIL SURFACE WITH PROPOSED SYSTEM OF HEATING.

Then if the pipe coil efficiency is 500 B.T.U. per square foot it will take 1,200 × 60 × 10/55 × 500 = 26 sq. ft. of coil surface to heat the air to 70° for the 40-pupil rooms and 1,500 × 60 × 10/55 × 500 = 33 sq. ft. for the 50-pupil rooms.

If, under ordinary conditions, the room required 40 sq. ft. of cast-iron radiation to heat it, the heat delivery is 40 × 250 = 10,000 B.T.U. This amount of heat supplied under the new conditions would require 10,000/500 = 20 sq. ft. of coil surface. Thus the coil surface for a 40-pupil room with a 40-sq. ft. radiator would be 26 + 20 = 46 sq. ft. and for a 50-pupil room 33 + 20 = 53 sq. ft. Similarly for a 40-pupil room if the required C.I. radiator is 130 sq. ft. the heat delivery is 130 × 250 = 32,500 B.T.U. and the coil surface 32,500/500 = 65 sq. ft. to which is added the coil surface for ventilating or 65 + 26 = 91 sq. ft. of coil for a 40-pupil room and 65 + 33 = 98 sq. ft. for a 50-pupil room.

These results have been plotted on

the chart shown in Fig. 7. The normal amount of cast-iron radiation is shown in the column at the left while the pipe coil surface is indicated by the scale across the bottom of the chart. The diagonal dot and dash line indicates when the coil surface will equal the cast-iron radiator surface. The heavy solid line marked 1,500 shows the coil surface required (with 1,500 c.f.m.) for any given room radiation while the parallel line marked 1,200 indicates the same for 1,200 c.f.m. It can be seen from this chart that a 1,500 f.p.m. room requiring *over* 52 sq. ft. of cast-iron radiation would need *less* pipe-coil radiation and a 1,200 f.p.m. room *less* if requiring *over* 67 sq. ft. of cast-iron radiation. Of course, conditions may modify the arrangement shown and, in some cases, it may be advisable to use regular indirect cast-iron surface in place of the coils.

It is desired to call attention to the narrow slot used for the admission of the heated air along the window. This is to secure a more equal flow across the face of the window and may be calculated on the basis of 400 ft. velocity out of the slot assuming a slot, say, 3 in. wide. Then for a 1,200-c.f.m. room, the total area of slot would be 1,200/400 = 3 sq. ft., or 3 × 144 = 432 sq. in. The slot, being 3 in. wide, measures 432/3 or 144 lin. in. of slot; 144/12 = 12 lin. ft. which divided among, say, three windows gives four lineal feet of slot per window. This slot, of course, can be narrowed and lengthened out, or can be widened to supply a larger volume of air.

While practical difficulties may be encountered in trying to work out such a scheme it would seem that it, at least, has enough desirable features to entitle it to serious consideration.

◆

Measurements of Low-Pressure Steam Used for Heating the Buildings of the University of Michigan

By J. E. EMSWILER,

Associate Professor of Mechanical Engineering, University of Michigan.

(Presented at the annual meeting of The American Society of Heating and Ventilating Engineers, in New York, January 22-24, 1918.)

In this paper are presented some data relative to the amount of steam required to heat the buildings of the University of Michigan, and the velocity with which the steam is conveyed through some of the pipes, together with a description of the method employed in the measurements.

The experiments, herein described, were undertaken at the request of the Buildings and Grounds Department of the university, to determine the velocity and quantity of steam that is being carried through the low-pressure heating mains fed from the central heating plant. The Buildings and Grounds Department is confronted with the problem of soon extending the central heating system to serve the new Michigan Union Building, as well as that of providing heat for the new and larger library. Some information as to the present load on the heating mains was therefore necessary, and it was in this connection that the experiments were made.

The low-pressure steam furnished for heating is made up in part of the exhaust from the 500 k.w. main generating unit of the plant and its auxiliaries. But the amount of exhaust steam is by far too small in colder weather, and the greater part of the steam used for heating is delivered directly into the low pressure main through a reducing pressure valve from the high pressure header in the plant. The proportion of exhaust steam and reduced pressure steam of course varies throughout the day with the variation in load on the engine unit, but the average for the winter time is about 25% exhaust and 75% reduced pressure steam.

The entire amount of heating steam is conveyed from the plant through a 20-in. main at pressures varying from 4 to 9 lbs. above atmospheric pressure. At the "substation," Fig. 1, just north of the Medical Building, the 20-in. main divides into four 12-in. pipe branches, of which one serves the gymnasium; one goes to the west, serving the Chemistry Building, Natural Science Building, Hill Auditorium, etc.; the other two go to the south, serving the building on the eastern side of the campus, and after being tied together in the old power house, one line passes to the west, serving the buildings in that direction and finally tying in with the other western branch by a 6-in. line, under University Hall, and so completing the campus loop. The diagram of Fig. 1 will readily explain the arrangement.

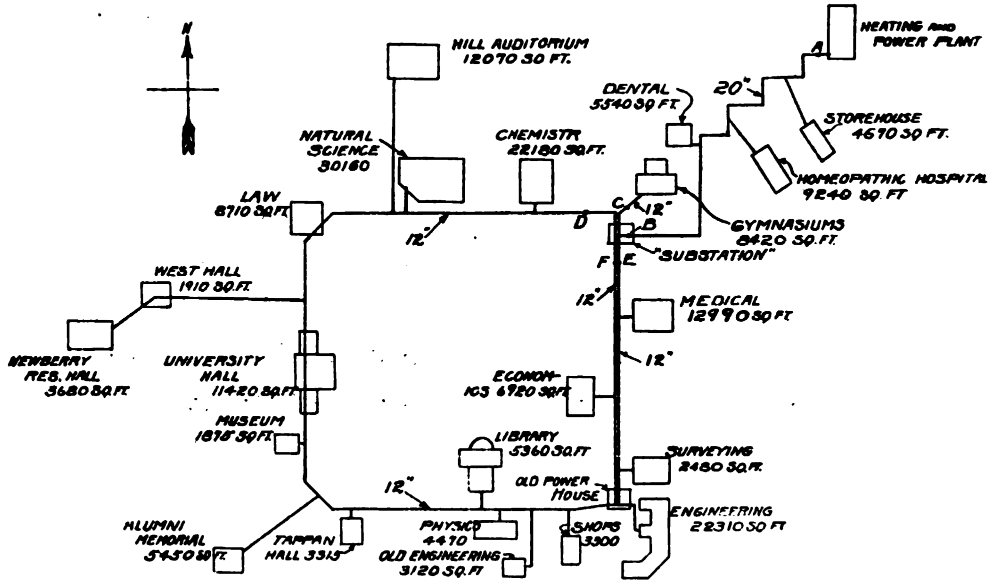


FIG. 1—DIAGRAM OF HEATING SYSTEM FOR BUILDINGS OF UNIVERSITY OF MICHIGAN.

The instruments of measurement employed were the Pitot tube and special manometer. The Pitot tube used is of the form shown in Fig 2. The static and total pressure elements are separate, *S* representing the static and *T* the total. The tip of the static element, presented to the current, is plugged and the end nicely rounded. There are three 1/16-in. holes on each side of the tip for the communication of static pressure. In addition, there is a row of three holes in the bottom of the tip, to permit any condensation which may have formed in the tube to drain out without obstructing the other openings. The total tube is, of course, open at the end of the tip. Both tubes are made of ¼-in. pipe, nickel plated. The large size was selected in order to obviate any possibility of a drop of water filling the cross-section and interfering with the communication of the true pressure.

The tubes enter the steam pipe through the stuffing boxes *B*. The total tube is of sufficient length to permit of a traverse of the pipe. *G* is a guide extending from the tube in the same direction as the tip, and serves to align the tip with the pipe. *V* is a valve for shutting off the steam from the connections, when necessary. *C* is the connection to the manometer. A pressure connection for a gage or mercury manometer can be made to the static tube beyond the valve *R*.

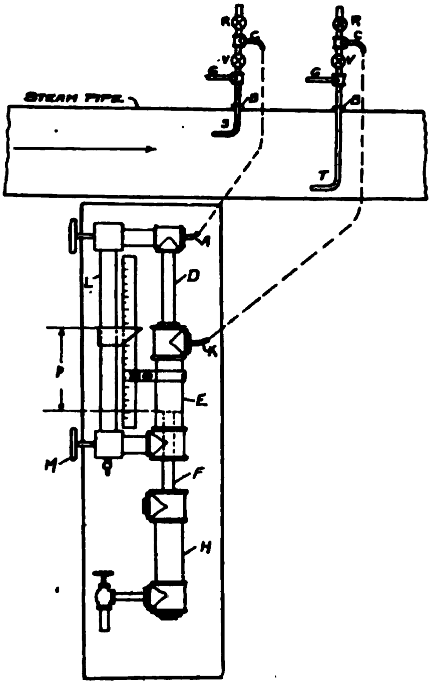


FIG. 2—FORM OF PILTOT TUBE USED IN MAKING STEAM MEASUREMENTS.

The form of manometer finally devised to register the differential pressure between total and static, that is the velocity pressure, is also illustrated in Fig 2. The static connection is made at *A*, the pressure being communicated to the ¾-in. gage glass *L*. The total pressure connection is made at *K*. The pressure is exerted upon the water in the 1-in. pipe chamber *E*. The part *D* is not a pipe, but merely a solid connector. The water in *E* stands at the level of the overflow pipe *F*, so that the height of water, *p*, in the glass above a zero reading on the scale corresponding to the top of the overflow pipe in *E* represents the velocity pressure of the steam in inches of water. Condensation in either *E* or *L* cannot accumulate and alter the level in *E*, so long as the overflow chamber *H* is not full.

It will be noted that the entire apparatus is constructed with the idea in mind of taking care of condensation as it is formed, and obviating any errors that might result from its presence. With the same thing in mind, the connecting pipes between the Pitot tube and manometer were relatively large in size, and the greatest care was exercised to see that there were no pockets for the accumulation of condensation. It was at first thought that rubber tubing could be used, but after some preliminary trials, it became apparent that the heat and pressure of the steam was beyond the limits of the rubber. Owing to the necessity of keeping the connecting tubes free of water at all times, the hot steam itself came in contact with the rubber, causing it to rot and ultimately rupture. Flexible metallic gas tubing was then tried but was soon found to develop small leaks. Finally, after the proper position of the total tube in the pipe had been determined by traversing, the connections between tubes and manometer were made of solid ¼-in iron pipe, and after that, no trouble was experienced.

LOCATION OF MEASURING INSTRUMENTS.

Pitot tubes were installed in the 20-in. line, near the substation. This location was known as station B. Similarly, tubes were installed in the several branches to the gymnasium, to the west, and the two to the south, and the stations were designated respectively C. D, E and F in Fig. 1. The combined flow measured at C. D. E and F, should total up to the amount measured at B, and this fact affords a check on the accuracy of measurement.

It was obviously out of the question to traverse the pipes at the frequent intervals of reading. The pipes were therefore traversed beforehand and a certain position for the total tube ascertained, at which point the same velocity pressures were indicated as resulted from the average of the ten points on the diameter of traverse. This matter of ascertaining an average position offered much more difficulty than might be expected. The rate of steam flow was subject to frequent and considerable variation, so that in traversing one could not be sure that a difference between readings at different points was due to difference of position of the total tube in the pipe. A plan was finally suggested which made a fairly satisfactory solution possible. The tube was set on a certain point in the traverse, say position 1. A reading was taken on the manometer and instantly the tube was slipped to position 2 and a reading on the manometer again taken. Then, after a few moments, a reading on position 2 was taken and the tube immediately slipped to position 1 and a reading taken there. This was repeated many times, the averages finally furnishing a pretty accurate relation between the velocity pressures at these two points. Then a comparison was made between positions 2 and 3, and so on across the pipe. The position of average reading having been established, the tube was set there and but a single indication was then necessary.

The pressure of the steam was indicated at stations B and D by mercury U-tubes. The temperature of the steam at B was registered by a thermometer in a well in the pipe. It is interesting to note that the steam was superheated at that point, usually to the extent of 40° or 50°.

Observations were begun at 3 p.m. on Thursday, February 1, and were continued for a week, ending Thursday, February 8. Readings at the five stations, B, C, D, E and F, were taken every fifteen minutes. The work was done by students of the Engineering College; the men worked in 8 hour shifts of two men each. Owing to difficulties in getting started and necessary changes in the apparatus, observations taken up to Sunday morning were not considered reliable and are not presented in the curves.

STEAM VELOCITY FORMULA USED.

The velocity of the steam is calculated by the equation $V^2 = 2gh$, where h refers to the velocity head measured in feet of the substance flowing. The working form of the equation reduces to

$$V = 1096 \sqrt{p} \sqrt{s}$$

where V = velocity in ft. per min.

p = velocity pressure in inches of water.

s = specific volume of steam.

The curves of Fig. 3 show the velocities of the steam in the several pipes, as well as the amount flowing, for the period of time from 7 a.m. Sunday, February 4, to 3 p.m. Thursday, February 8, when the observations were ended. The uppermost curve shows the outside temperature which prevailed at the time.

The velocity curves show that pipe D is much more heavily loaded than any of the others. The maximum velocity indicated is nearly 15,000 ft. per minute. Pipe B (20-in. main) is next, with a maximum velocity indicated of something over 12,000 ft. per minute.

Comparing the curves which show the flow through B (the 20-in. pipe) and the sum of the flows in the four branches, T, it is apparent that, while there is not perfect agreement, by any means, the check is sufficiently satisfactory considering the difficulties.

At night, the valves to all the 12-in. branches except D are usually shut between the hours of 10 or 11 p.m. to 3 or 4 a.m. and the amount of steam falls to a relatively low value.

The demand for steam is greatest during those hours of the day when

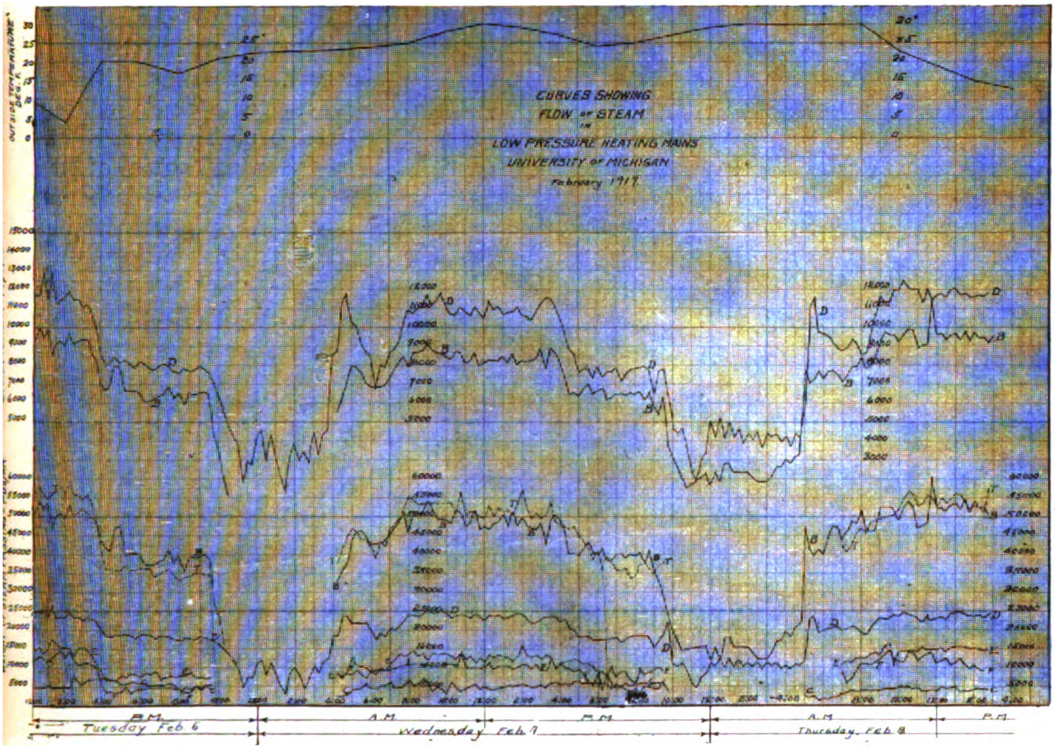


FIG. 3—RECORD OF STEAM FLOW IN UNIVERSITY OF MICHIGAN HEATING MAINS.

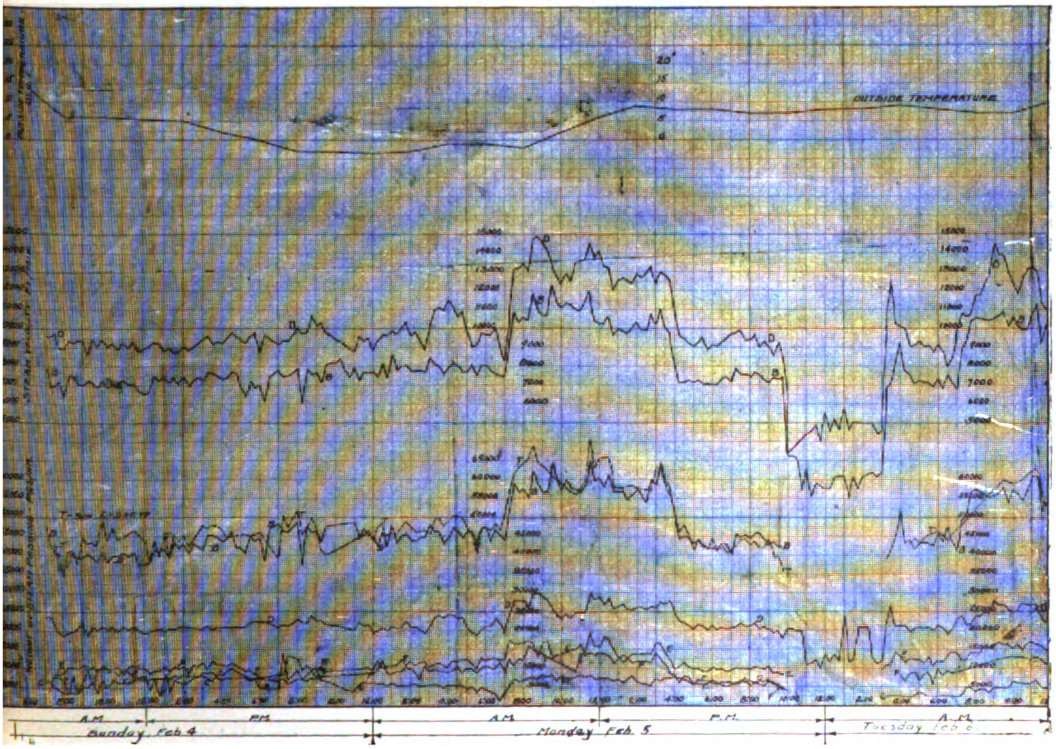


FIG. 3 (continued)—RECORD OF STEAM FLOW IN UNIVERSITY OF MICHIGAN HEATING MAINS.

the ventilating fans are on, that is—from about 8 a.m. until 4 p.m.

The maximum demand for steam was on Monday, which was the coldest day, when a rate of nearly 60,000 lbs. per hour, curve *B* or *T*, Fig. 3, was required for 8 hours. The average demand for steam on that day was about 47,000 lbs. per hour.

The total amount of radiation served by the steam measured is 170,140 sq. ft. and is distributed as shown by the diagram of Fig. 1. The figures above do not represent the entire amount of radiation in the university buildings. It will be noted in the diagram of Fig. 1 that there are three buildings between the heating plant and the "substation" that took off steam which therefore did not reach the place of measurement. Another building of 7,900 sq. ft. of radiation was served by high-pressure steam reduced at the building, and therefore not accounted for in the measurement. And finally the University Hospitals, with a total radiation of several thousand square feet, are heated by an independent plant.

DIFFICULTIES OF TEST.

With the method of measurement employed, some difficulties were encountered which it may be well to point out here.

Not only were there frequent variations in the flow, but there were rhythmic pulsations, due to the discharge of the low-pressure cylinder of the engine into the main. It seems incredible that the engine's discharge could be noticeable in a receiver 20 in. in diameter and nearly a third of a mile long, and yet every stroke of the engine is distinctly visible in its effect on the water level in the manometer, not only at station B in the 20-in. pipe, but in the stations in the branches, though to a lesser extent. These pulsations necessitated the partial closure of the valve *M* (Fig. 3), in order to dampen the fluctuations of the water in the glass and make observation possible. Pulsating flow introduces some error in itself and in this case probably causes another error by allowing some of the water in *E* (Fig. 3) to splash out through the overflow pipe and thus change the zero.

Any leakage in the apparatus or connecting tubes is fatal to accurate readings.

A difference in rate of condensation in the connecting tubes may introduce an appreciable error. This was guarded against as far as possible in the installation of the apparatus, and was further remedied by covering, or partially covering, some of the pipes so as to leave the same length exposed.

More nearly accurate results were undoubtedly obtained at the higher velocities, where the velocity pressure was large. It requires a velocity nearly 5,000 ft. per min., to cause a velocity pressure of 1 in. of water; whereas a velocity of 10,000 ft. per min. will give a reading of 4 in. The maximum velocity observed, about 15,000 ft. per minute caused a deflection of approximately 9 in. in the water level of the manometer.

A station was also established at A, on the 20-in. main, at a point near the heating plant (see diagram of Fig. 1). Only a few observations were made at A, partly because of the lack of men, and partly because of the more violent fluctuations in pressure due to the engine's exhaust.

Such observations as were obtained indicated that there was a loss of pressure from A to B, a distance of about 1,500 ft. of 20-in. pipe, of 3¾ in. of mercury with 57,000 lbs. of steam per hour passing A, and about 6,000 lbs. withdrawn for the buildings connected between A and B.

Also for the same conditions, there appeared to be but 2° or 2½° less superheat at B than at A. Taking into account both the drop in pressure and the small reduction of superheat, the actual loss of heat per pound of steam, by radiation, is about 2.7 B.T.U.. Assuming 53,000 lbs. per hour as the average rate of steam flow between A and B, the total loss of heat from the 20-in. pipe is 143,000 B.T.U. per hour. The average temperature of the steam within the pipe was about 270°, and that of the air in the tunnel, about 130°, the difference being 140°. The total surface of the 20-in. pipe between A and B is about 7,800 sq. ft. On the basis of these figures, the heat loss is about 0.13 B.T.U. per hour per square foot per degree difference in temperature, which seems rather low, even though the pipe is very well covered. The close proximity of other pipes in the tunnel may have an influence also.

It is evident that this installation furnishes some possibilities for obtaining very valuable information, relating to the friction of steam flowing in pipes, and it is proposed to attempt further investigation of this problem during the next year (1918).

CHICAGO COMMISSION ON VENTILATION

Ventilation Test in an Old Building

The Dante Grammar School, Chicago, Ill.

EDITED BY SAMUEL R. LEWIS

(Continued from February issue.)

Dante No. 209

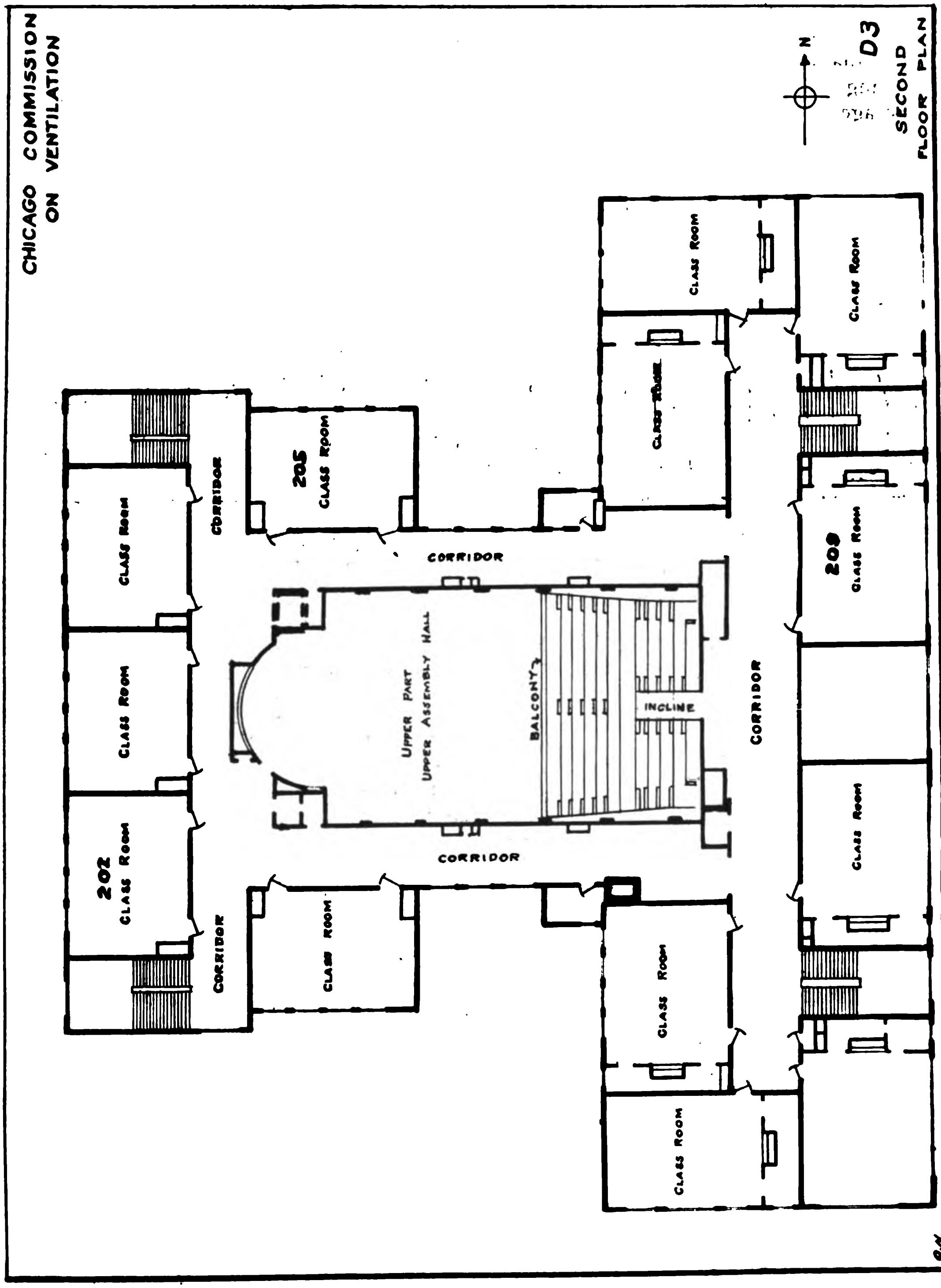
Feb. 15, 1917.

Lewis Champlin No. 104, March 8. These tests may fairly be compared, as both were on the leeward side.

	Cubic Feet Air space per Pupil	C.F.M. per Pupil	Ave. Temp. Deg.F. Dry	Wet	Av. Rel. Humidity Per Cent.	Av. Dust	Av. Bacteria	Av. CO_2	Excess CO_2 over outside
Dante 209	262	31	49	66	26	17200	7	6.9	3.5
Lewis Champlin 104	340	42	53	69	31	40000	5.7	6.7	3.5

The leakage was outward in both rooms, in the Dante being 11% of the supply, and in the Lewis Champlin 20%. In this case the Lewis Champlin pupils were receiving considerably more fresh air than those at the Dante. The supply opening at the Dante was at the center of the room on an interior wall, delivering the air parallel with the glass, and was 96x7¾ in. At the Lewis Champlin the supply opening was on an interior wall, delivering the air toward the glass and was 72x19 in. The CO_2 outside was 3.4 parts for the Dante, and 4 parts for the Lewis Champlin.

The exhaust openings for the Dante are two in number through the doorways into the wardrobe, on each side of the supply, while those at the Lewis Champlin are on the interior wall, alongside the supply. In this comparison we have conditions for Dante 209 very like Lewis Champlin 209, as the air seems to pass around the room, and practically all of the contaminated air leaves through the cloak-room doorway near the outside wall. The CO_2 index shows fairly even results,



SECOND FLOOR PLAN, DANTE GRAMMAR SCHOOL.

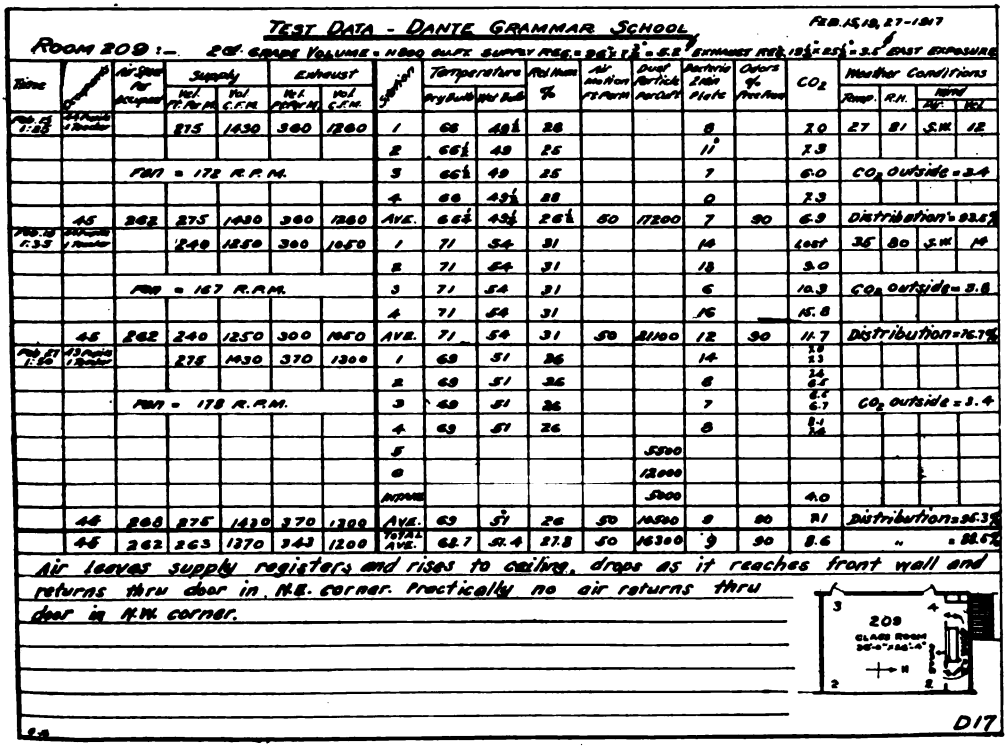
and uniform distribution as long as hot air is being introduced. On February 19, however, air at about 70° F. was probably entering, and it appears to have short-circuited to the east outlet, accounting for the high CO_2 at stations 3 and 4. Lewis Champlin 104 is popularly supposed to represent first-class location of supply and exhaust, and the CO_2 results seem to bear this out, though with so large a volume of fresh air per pupil per minute it seems reasonable to expect better ventilation than the tests show, for Lewis Champlin 104.

The automatic humidity controlling apparatus at the Lewis Champlin school showed its superiority over the hand-control of the Dante, as the temperature and humidity at the latter were properly related, while the former was deficient, even for the low temperature.

The Dante school again showed the more favorable condition as to dust, while the Lewis Champlin school showed the lower bacteria count.

There is nothing to be observed in the results from a comparison of these tests to change the conclusions stated for the Dante kindergarten and Lewis Champlin 209. Dante 306 and 311 are similar to Dante 209 in plan, and the results of the tests are reasonably consistent. All are characterized by very considerable outward leakage. As the conditions favor the freshest air always being along the cooling surfaces of the windows, it is this freshest air which leaks out, resulting in deficiency of fresh air, particularly along the interior walls.

Less dust was usually observed at all tests of the Dante school than was observed at the Lewis Champlin school. It usually increased as the outdoor humidity decreased. The moisture content was almost always out of adjustment with the dry-bulb temperature, and was usually too low



TEST DATA - DANTE GRAMMAR SCHOOL

FEB. 15, 19, 27-1917

ROOM 209 :— 2nd GRADE VOLUME = 11800 CU. FT. SUPPLY REG. = 26½ x 28½ = 5.2 EXHAUST REG. 19¾ x 25½ = 3.5 EAST EXPOSURE

Time	Occupants	Air Space per Occupant	Supply Vel. Ft. Per M.	Supply Vol. C.F.M.	Exhaust Vel. Ft. Per M.	Exhaust Vol. C.F.M.	Station	Temperature Dry Bulb	Temperature Wet Bulb	Rel. Hum. %	Air Motion Ft. Per M.	Dust Particles Per Cu. Ft.	Bacteria 2 Min. Plate	Odors % Free From	CO_2	Weather Temp.	Weather R.H.	Wind Dir.	Wind Vel.
Feb. 15 1:25	44 Pupils 1 Teacher		275	1430	360	1260	1	66	49½	28			8		7.0	27	81	S.W.	12
							2	66½	49	25			11		7.3				
		Fan = 172 R.P.M.					3	66½	49	25			7		6.0	CO_2 outside = 3.4			
							4	66	49½	28			0		7.3				
	45	262	275	1430	360	1260	AVE.	66¼	49¼	26½	50	17200	7	90	6.9	Distribution = 93.5%			
Feb. 19 1:35	44 Pupils 1 Teacher		240	1250	300	1050	1	71	54	31			14		Lost	35	80	S.W.	14
							2	71	54	31			18		9.0				
		Fan = 167 R.P.M.					3	71	54	31			6		10.3	CO_2 outside = 3.8			
							4	71	54	31			16		15.8				
	45	262	240	1250	300	1050	AVE.	71	54	31	50	21100	12	90	11.7	Distribution = 76.7%			
Feb. 27 1:50	43 Pupils 1 Teacher		275	1430	370	1300	1	69	51	26			14		7.8 7.3				
							2	69	51	26			6		7.4 6.5				
		Fan = 178 R.P.M.					3	69	51	26			7		6.6 6.7	CO_2 outside = 3.4			
							4	69	51	26			8		8.1 7.4				
							5					5500							
							6					12000							
							Intake					5000			4.0				
	44	268	275	1430	370	1300	AVE.	69	51	26	50	10500	9	80	7.1	Distribution = 95.3%			
	45	262	263	1370	343	1200	TOTAL AVE.	68.7	51.4	27.8	50	16300	9	90	8.6	" = 88.5%			

Air leaves supply registers and rises to ceiling, drops as it reaches front wall and returns thru door in N.E. corner. Practically no air returns thru door in N.W. corner.

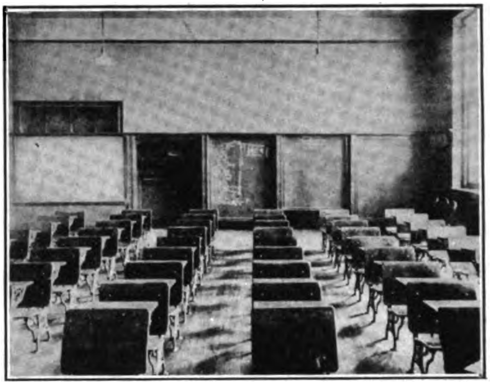
TEST DATA FOR ROOM 209.

for comfort; the dry-bulb temperature was too high. The air delivered was always considerably in excess of 30 cu. ft. per occupant per minute, as measured by anemometer, and was always deficient as measured by CO_2 index. These rooms all had long inlets, shallow as to vertical dimensions, and all exhibited the injector effect, drawing up contaminated air with the fresh air jet.

Dante 105, 304, 202 and 205.

Feb. 15, 19-28, March 1, 1917.

Dante 105, 304, 202 and 205 are similar in plan. In all of them the leakage was outward. In all of them the supply openings were about 72x19 in. and the injector effect was not noticed. The same criticisms as above outlined apply to the humidity adjustment. The tendency was to carry too high a dry-bulb temperature. The results observed are not consistent with those observed in Lewis Champlin 209, the plan of which is similar.



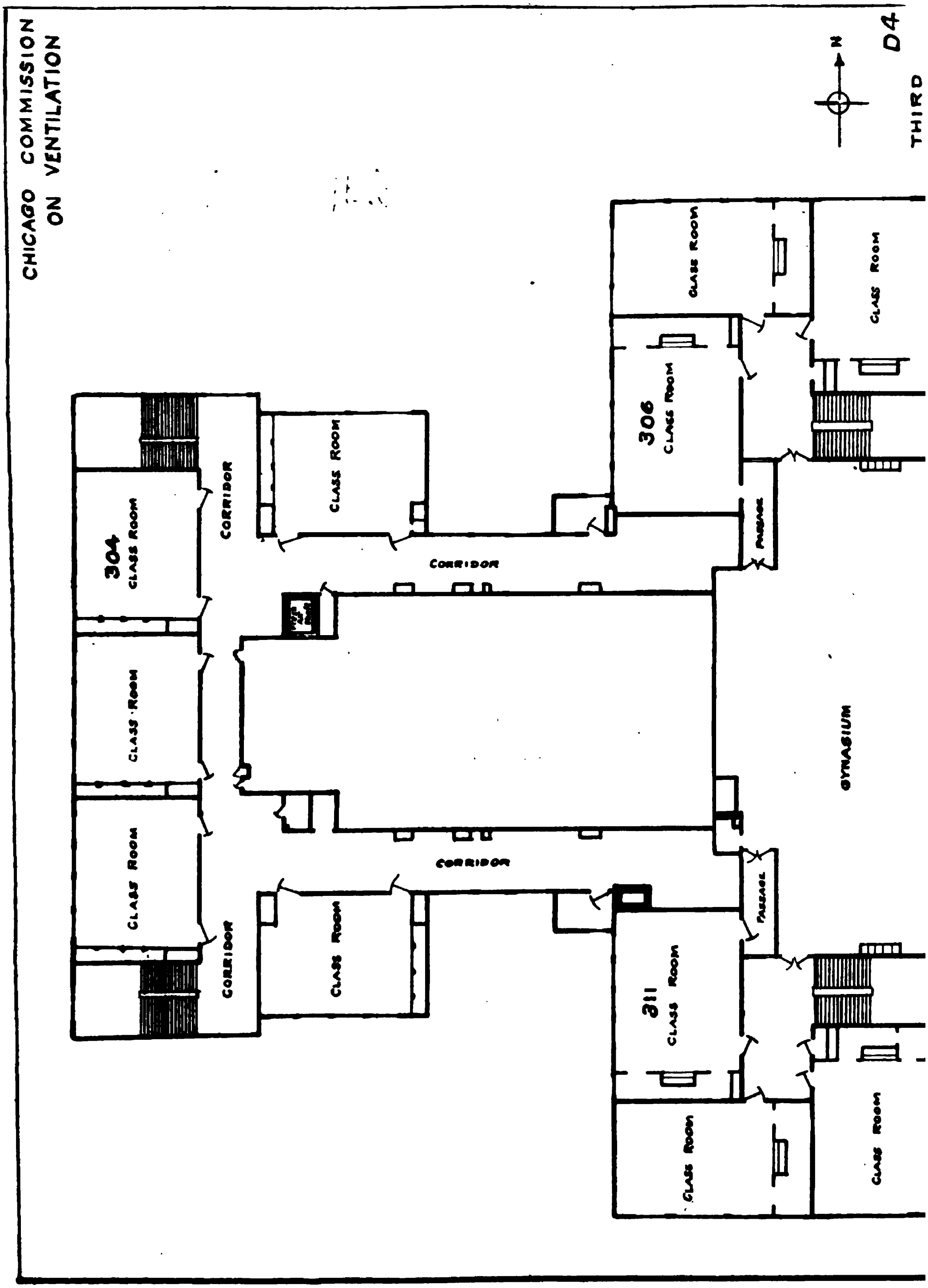
CLASSROOM NO. 105, SHOWING AIR SUPPLY, AT LEFT, AND EXHAUST SPACE UNDER WARDROBE BEHIND BLACKBOARDS.

	C.F.M. per Pupil	Percent Leakage out.	Av. CO_2	Excess CO_2 over outside	Cubic Feet Air space per Occupant	Temp. Dry Bulb Deg. F.	CO_2 out-side
Lewis Champlin 209	30	25	6.4	2.2	290	70	4.2
Dante 304	40	33	9.7	6.0	257	72	3.7
Dante 202	40	34	10.4	6.7	263	74	3.7
Dante 105	47	43	7.2	3.5	340	73	3.7
Dante 205	47	24	7.3	3.6	295	71	3.7

Rooms 102, 202 and 304, for instance, all have west exposure, and were tested the same days under the same wind conditions. The following may account for the apparent discrepancies, which we will endeavor to locate by further tests:

The thermostats in all of these rooms are set too high. It is possible that warm air was being delivered to Lewis Champlin 209 and Dante 105 and 205 when the CO_2 tests were made, while cool air was entering Dante 202 and 304 when the tests were made. It was noted in 202 that draft was perceptible at the breathing line, while the lack of movement near the windows would be accounted for by a cool air delivery. In room 105, February 28, with dry-bulb 74 the CO_2 showed poor distribution, accountable by a cool air delivery. (The thermostat may have just been caused by the high temperature, to reverse the dampers, and the themometer may not have had time to respond.) This same effect probably accounts for the uneven CO_2 at dry-bulb 74° in 304, Feb. 15. No other plausible explanation occurs to us. The leakage is excessive, but the greatest leakage occurs in 105, the average condition of which is not inconsistent with Lewis Champlin 209. It is obvious that reducing the Dante leakage is advisable.

In testing the Lewis Champlin school rooms 201 and 301, particularly favorable results were observed in rooms similar to the foregoing Dante rooms except that the supply openings were diagonally opposite the outlets. We will compare Dante 205 average, perhaps the best of its type, with Lewis Champlin 201, March 9.


CHICAGO COMMISSION
ON VENTILATION
D4
N
THIRD
CLASS ROOM
304
CLASS ROOM
CLASS ROOM
CLASS ROOM
CORRIDOR
CORRIDOR
CLASS ROOM
CORRIDOR
CORRIDOR
CLASS ROOM
306
CLASS ROOM
CLASS ROOM
CLASS ROOM
PASSAGE
GYMNASIUM
PASSAGE
311
CLASS ROOM
CLASS ROOM
CLASS ROOM

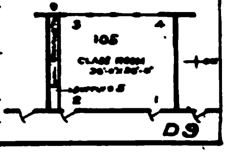
TEST DATA - DANTE GRAMMAR SCHOOL

FEB. 15, 19, 28 - 1917

ROOM 105 1st GRADE VOLUME = 11800 CU. FT. - SUPPLY REG. = 28"×18½" = 3.6 - EXHAUST REG. = 30"×16½" = 3.4 - WEST EXPOSURE

Time	Occupants	Air Space Per Occupant	Supply Vel. Ft. Per Min.	Supply Vol. C.F.M.	Exhaust Vel. Ft. Per Min.	Exhaust Vol. C.F.M.	Station	Temperature Dry Bulb	Temperature Wet Bulb	Rel. Hum. %	Air Motion Ft. Per Min.	Dust Particles Per Cu. Ft.	Bacteria 2 Min. Plate	Odors % Free From	CO_2	Weather Temp.	Weather R.H.	Wind Dir.	Wind Vel.
Feb. 15 11:10	45 Pupils 1 Teacher		200	1920	290	990	1	73	52	20½			14	-	6.0	28	80	S.W.	12
							2	71½	51½	22½			11		6.0				
		Fan = 152 R.P.M.					3	71½	51½	22½			8		6.1	CO_2 outside = 3.4			
							4	73	52	20½			5		5.4				
	46	256	200	1920	290	990	Ave.	72¼	51¾	21½	60	12000	10	90	5.9	Distribution = 96.5%			
Feb. 19 2:50	24 Pupils 1 Teacher		155	1430	200	680	1	73	54	26			12		7.5	35	80	S.W.	14
							2	72½	54	27			24		5.1				
		Fan = 146 R.P.M.					3	72½	54	27			20		6.0	CO_2 outside = 3.8%			
							4	73	54	26			10		7.0				
	25	470	155	1430	200	680	Ave.	72¾	54	26½	50	27500	18	90	6.4	Distribution = 85.7%			
Feb. 28 11:15	39 Pupils 1 Teacher		184	1860	305	1040	1	74	54	24		85000	17		11.0 7.5	27	40	N.	9
							2	74	54	24		"	22		7.8 7.0				
		Fan = 146 R.P.M.					3	73½	53½	23		"	5		11.8 11.4	CO_2 outside = 4.0			
							4	73½	53½	23		"	6		8.4 6.0				
							5					85000							
							6					100000							
							Intake					28000			7.5				
	40	295	184	1860	305	1040	Ave.	73¾	53¾	23½	50	85000	13	90	8.2	Distribution = 83.5%			
	37	340	183	1760	265	900	Total Ave.	73	53	23½	53	41700	14	90	7.2	" = 90.1%			

Air motion was such that a slight draft was felt at heads of pupils in east center of room; at front the air rose and turned to west where it dropped to breathing zone and returned to exhaust in south wall.



G.M.

TEST DATA FOR ROOM 105.

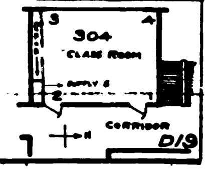
TEST DATA - DANTE GRAMMAR SCHOOL

FEB. 15, 19, 28, 1917

ROOM 304 7th GRADE VOLUME = 11800 CU. FT. SUPPLY REG. = 72"×19½ = 9.7 EXHAUST REG. = 30"×20" = 4.2 WEST EXP.

Time	Occupants	Air Space Per Occupant	Supply Vel. Ft. Per Min.	Supply Vol. C.F.M.	Exhaust Vel. Ft. Per Min.	Exhaust Vol. C.F.M.	Station	Temperature Dry Bulb	Temperature Wet Bulb	Rel. Hum. %	Air Motion Ft. Per Min.	Dust Particles Per Cu. Ft.	Bacteria 2 Min. Plate	Odors % Free From	CO_2	Weather Temp.	Weather R.H.	Wind Dir.	Wind Vel.
Feb. 15 1:45	44 Pupils 1 Teacher		180	1750	280	1180	1	74½	54	23			2		14.8	27	81	S.W.	16
							2	74½	54	23			2		10.0				
		Fan = 146 R.P.M.					3	74½	54	23			3		11.8	CO_2 outside = 3.4			
							4	74½	54	23			2		7.7				
	45	262	180	1750	280	1180	Ave.	74½	54	23	50	14700	3	90	11.1	Distribution = 80%			
Feb. 19 11:40	43 Pupils 1 Teacher		205	1980	305	1280	1	72	52	22			12		8.6	29	83	S.W.	14
							2	72	52	22			4		8.7				
		Fan = 150 R.P.M.					3	72	52	22			6		8.1	CO_2 outside = 3.8			
							4	72	52	22			9		6.8				
	44	268	205	1980	305	1280	Ave.	72	52	22	50	22800	6	90	8.0	Distribution = 91.5%			
Feb. 28 2:35	48 Pupils 1 Teacher		190	1840	300	1260	1	72	53	26			4		11.2 10.0	27	49	N	9
							2	72	53	26			3		8.3 9.0				
		Fan = 148 R.P.M.					3	72	53	26			14		9.6 10.8	CO_2 outside = 4.0			
							4	72	53	26			10		10.3				
							5					36000							
							6					42000							
							Intake					28000			10.0				
	49	241	190	1840	300	1260	Ave.	72	53	26	50	38000	8	90	10.0	Distribution = 92.5%			
	46	257	192	1860	295	1240	Total Ave.	72.8	53	24	50	25200	5	90	9.7	" = 88.%			

Air rises to ceiling from supply register drops at front of room and returns in breathing zone to exhaust in rear.



TEST DATA FOR ROOM 304.

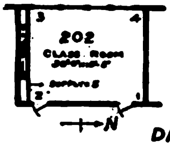
TEST DATA - DANTE GRAMMAR SCHOOL

Feb. 15, 19, 28, 1917

ROOM 202 4th GRADE VOLUME = 11800 CU.FT. SUPPLY REG. 32"×18½" = 2.7 EXHAUST REG. = 30"×20" = 4.2 WEST EXPOSURE

Time	Occupants	Air Space per Occupant	Supply Vel. Ft. Per Min.	Supply Vol. C.F.M.	Exhaust Vel. Ft. Per Min.	Exhaust Vol. C.F.M.	Station	Temperature Dry Bulb	Temperature Wet Bulb	Rel. Hum. %	Air Motion Ft. Per Min.	Dust Particles Per Cu. Ft.	Bacteria 2 Min. Plate	Odors % Positive	CO_2	Weather Temp.	Weather R.H.	Wind Dir.	Wind Vel.
Feb. 15 2:05	43 Pupils 1 Teacher		190	1850	270	1140	1	77	55	21			8		12.1	28	80	S.W.	12
							2	77	55	21			16		14.0				
		Fan = 150 R.P.M.					3	77	55	21			8		9.9	CO_2 outside = 3.4			
							4	77	55	21			5		11.5				
	44	270	190	1850	270	1140	AVE.	77	55	21	50	19600	9	90	11.1	Distribution = 93.9%			
Feb. 19 2:00	43 Pupils 1 Teacher		180	1750	280	1180	1	72	56	35			8		13.1	35	80	S.W.	14
							2	72½	56½	36			5		16.0				
		Fan = 146 R.P.M.					3	72½	56½	35			7		9.2	CO_2 Outside = 3.8%			
							4	72	56	35			2		8.8				
	44	270	180	1750	280	1180	AVE.	72½	56½	35	50	20200	5.5	85	10.6	Distribution = 72.4%			
Feb. 28 1:45	46 Pupils 1 Teacher		188	1830	290	1220	1	74	53	20			3		10.2 10.4	30	53	N.E.	8
							2	74	53	20			4		8.6 8.6				
		Fan = 150 R.P.M.					3	74	53	20			2		12.5 8.5	CO_2 outside = 4.0			
							4	74	56	20			5		12.3 7.3				
							5					26000							
							6					33500							
							Intake					28000							
	47	250	188	1830	290	1220	AVE.	74	53	20	60	37000	3½	90	9.8	Distribution = 93.9%			
	45	263	186	1810	280	1180	Total Ave.	74.4	54.7	25	50	25600	6	88	10.4	" = 86.7%			

Air in leaving register drops too closely to tops of heads at east end: curls around the front of room and returns on west side in breathing zone. On Feb. 19 there was very little motion near windows to air returning along center of room.



64

D13

TEST DATA FOR ROOM 202.

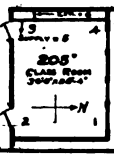
TEST DATA - DANTE GRAMMAR SCHOOL

FEB. 15, 19, MCH. 1, 1917

ROOM 205 3rd GRADE VOL. = 11800 CU.FT. SUPPLY REG. = 72"×18½" = 9.7 EXHAUST REG. = 30"×20" = 4.2 NORTH EXPOSURE

Time	Occupants	Air Space per Occupant	Supply Vel. Ft. Per Min.	Supply Vol. C.F.M.	Exhaust Vel. Ft. Per Min.	Exhaust Vol. C.F.M.	Station	Temperature Dry Bulb	Temperature Wet Bulb	Rel. Hum. %	Air Motion Ft. Per Min.	Dust Particles Per Cu. Ft.	Bacteria 2 Min. Plate	Odors % Positive	CO_2	Weather Temp.	Weather R.H.	Wind Dir.	Wind Vel.
Feb. 15 2:30	39 Pupils 1 Teacher		200	1940	360	1510	1	70	50	20			14		6.1	28	80	S.W.	12
							2	70	50	20			28		5.6				
		Fan = 150 R.P.M.					3	69	50	23			27		7.7	CO_2 Outside = 3.4			
							4	69	50	23			17		6.2				
	40	295	200	1940	360	1510	AVE.	69½	50	21½	60	15100	22	90	6.4	Distribution = 88.8%			
Feb. 19 1:50	37 Pupils 1 Teacher		210	2040	350	1470	1	70½	54	32			3		7.1	35	80	S.W.	14
							2	70½	54	32			6		10.4				
		Fan = 150 R.P.M.					3	70½	54	32			6		7.4	CO_2 outside = 3.8%			
							4	70½	54	32			4		7.5				
	38	310	210	2040	350	1470	AVE.	70½	54	32	60	19000	5	90	8.1	Distribution = 85.8%			
Mch. 1 11:00	40 Pupils 1 Teacher		180	1750	315	1320	1	73	50	15			2		5.8 6.3	20	58	N	11
							2	73	50	15			5		7.7 7.5				
		Fan = 145 R.P.M.					3	73½	51	17			5		5.8 7.8	CO_2 outside = 4.0			
							4	74	51	16			2		8.0 8.8				
							5					7500							
							6					15000							
							Intake					28000			3.8				
	41	288	180	1750	315	1320	AVE.	73.4	50½	16	50	21000	3½	90	7.3	Distribution = 80.1%			
	40	296	191	1910	342	1435	Total Ave.	71.1	51.5	23.2	57	18400	10	90	7.3	" = 85.3%			

Air leaves supply register in S.W. corner and travels rather low to N.E. corner and returns on north side with a tendency toward S.W. corner.



62

D15

TEST DATA FOR ROOM 205.

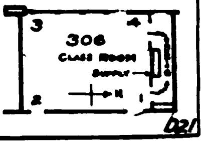
TEST DATA - DANTE GRAMMAR SCHOOL

FEB. 15, 19, 27 - 1917

ROOM 306 6TH GRADE VOLUME = 11800 CU. FT. SUPPLY REG. = 36" × 7½" = 5.2 □' EXHAUST REG. = 19½" × 25½" = 3.5 □' WEST EXPOSURE

Time	Occupants	Air Space per Occupant	Supply Vel. Ft. Per M.	Supply Vol. C.F.M.	Exhaust Vel. Ft. Per M.	Exhaust Vol. C.F.M.	Station	Temperature Dry Bulb	Temperature Wet Bulb	Rel. Hum. %	Air Motion Ft. Per M.	Dust Particles Per Cu. Ft.	Bacteria 2 Min. Plate	Odors % Free From	CO₂	Weather Conditions Temp.	R.H.	Wind Dir.	Wind Vel.
Feb. 15 9:00	42 Pupils 1 Teacher		350	1820	225	790	1	73½	53½	23			2		9.8	27	81	S.W.	16
							2	74	53	20			1		12.4				
		Fan = 164 R.P.M.					3	74	53	20			3		6.8	CO₂ outside = 3.4			
							4	73½	53½	23			12		9.0				
	43	275	350	1820	225	790	AVE.	73½	53¼	21½	50	11600	4	90	9.5	Distribution = 83.3%			
Feb. 19 10:00	41 Pupils 1 Teacher		440	2230	400	1400	1	71	51	22			18		11.1	29	83	S.E.	21
							2	71	51	22			3		9.4				
		Fan = 174 R.P.M.					3	71	51	22			21		7.8	CO₂ outside = 3.8			
							4	71	51	22			11		8.4				
	42	280	440	2230	400	1400	AVE.	71	51	22	50	20600	13	90	9.2	Distribution = 88.0%			
Feb. 27 9:30	40 Pupils 1 Teacher		375	1950	400	1400	1	73	53	24			4		7.2 7.5	25	50	N	8
							2	73	52	22			2		7.8 8.0				
		Fan = 172 R.P.M.					3	73	52	22			2		7.4 6.4	CO₂ outside = 3.4			
							4	73	53	24			2		8.7 8.0				
							5					5000							
							6					12000							
							INTAKE					5000							
	41	288	375	1950	400	1400	AVE.	72½	52½	23	50	10000	3	95	7.9	Distribution = 91.8%			
	42	280	390	2030	340	1200	TOTAL AVE.	72.4	52.3	22.2	50	14100	7	92	8.8	" = 87.8%			

Air after leaving supply register travels to ceiling and on striking front wall drops to floor and returns in breathing zone - equal amounts passing thru each door leading to exhaust.



O.H.

D21

TEST DATA FOR ROOM 306.

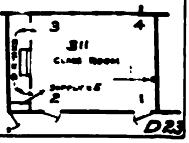
TEST DATA - DANTE GRAMMAR SCHOOL

FEB. 15, 19, 19, MCH. 1, 1917

ROOM 311 4TH GRADE VOLUME = 11800 CU. FT. SUPPLY REG. = 36" × 7½" = 5.2 □' EXHAUST REG. = 19½" × 25½" = 3.5 □' WEST EXPOSURE

Time	Occupants	Air Space per Occupant	Supply Vel. Ft. Per M.	Supply Vol. C.F.M.	Exhaust Vel. Ft. Per M.	Exhaust Vol. C.F.M.	Station	Temperature Dry Bulb	Temperature Wet Bulb	Rel. Hum. %	Air Motion Ft. Per M.	Dust Particles Per Cu. Ft.	Bacteria 2 Min. Plate	Odors % Free From	CO₂	Weather Conditions Temp.	R.H.	Wind Dir.	Wind Vel.
Feb. 15 8:15	36 Pupils 1 Teacher		340	1770	400	1400	1	73	52	20½			4		8.0	27	81	SW	16
							2	73	52	20½			5		6.2				
		Fan = 172 R.P.M.					3	73	52	20½			1		10.0	CO₂ outside = 3.4			
							4	73	52	20½			5		10.0				
	37	320	340	1770	400	1400	AVE.	73	52	20½	50	14000	4	85	8.6	Distribution = 83.1%			
Feb. 19 11:30	38 Pupils 1 Teacher		350	1820	365	1280	1	72	52	22			7		8.1	29	83	S.E.	21
							2	72	52	22			15		9.6				
		Fan = 172 R.P.M.					3	72	52	22			8		9.0	CO₂ outside = 3.8			
							4	72	52	22			7		9.0				
	39	300	350	1820	365	1280	AVE.	72	52	22	50	24600	9	86	9.2	Distribution = 97.8%			
Mch. 1 11:30	35 Pupils 1 Teacher		240	1250	455	1600	1	72	51	19			0		6.7 7.6	20	53	N	N
							2	70½	50½	21			15		12.0 6.3				
		Fan = 164 R.P.M.					3	71	50½	20			15		11.5 8.0	CO₂ outside = 4.0			
							4	71	50½	20			12		8.8 10.0				
							5					50000							
							6					43000							
							INTAKE					22000			3.8				
	36	330	240	1250	455	1600	AVE.	71	50½	20	40	46000	13	90	9.0	Distribution = 90.0%			
	37	320	310	1610	406	1420	TOTAL AVE.	72	51.5	21	47	27900	9	87	8.9	" = 90.3%			

Air after leaving supply traveled straight for front wall where it dropped and returned both sides of room. There was a strong tendency for air in breathing zone to rise and mix with the fresh air and travel forward again.



O.H.

D23

TEST DATA FOR ROOM 311.

	Cubic Feet Air space Per Pupil	C.F.M. Per Pupil	Av. Deg.F. Dry	Temp. Wet	Av. Rel. Humidity PerCent	Av. Dust	Av. Bacteria	Av. CO_2	Excess CO_2 over outside
Lewis Champlin 201	266	24	73	54	26½	21000	15.2	7.1	2.9
Dante 205	295	47	71	51	23	18400	10	7.3	3.6

Outside CO_2—Lewis Champlain 4.2; Dante 3.7
Leakage out—Lewis Champlin 41%; Dante 24%

Thus, given greater leakage, higher temperature, less air space per occupant, and only 51% of the air per minute per occupant, so much better was the Lewis Champlin arrangement, with its whirling or corkscrew movement of the entire room content, simulating ventilation by displacement, that the CO_2 index was about equal to that at the Dante.

Conclusion:

We believe that from the tests of the various rooms in both buildings the following may fairly be deduced, and while perhaps not conclusive, each should be particularly noted and studied in further tests:

1. The nearer we approach ventilation by displacement rather than ventilation by dilution, the better results we will attain.
   a. High inlet velocities by their injector effect militate against ventilation by displacement.
   b. The best results are attained in the rooms tested where the relation of supply and exhaust is such as to set up a corkscrew form of air travel from supply to exhaust, the supply being preferably on an interior wall, the exhaust preferably nearer the exposure than the supply.
2. All observations prove our agreement that the delivery of a given volume of fresh air into a room does not necessarily constitute ventilation, and from this—
   a. Leakage outward is undesirable, since the air which is thus lost is usually fresh air, reducing correspondingly the fresh air change in the occupied parts of the room.
   b. A large volume of space per occupant is not especially desirable so far as it affects the operation of mechanical ventilation, and with comparatively low ceilings it is easier to create a proper air movement over the bodies of the occupants.
3. Dust and bacteria do not coordinate as far as the tests of the Lewis Champlin and Dante schools indicate.
4. The steam jet humidifiers are capable of furnishing sufficient moisture, but hand regulation of these devices, as at the Dante school, is not satisfactory.
5. The engine-driven fans are highly desirable for ease of regulation and economy of operation, but some means should be provided to insure constant and proper fan speed so as to deliver the required volume of air when the buildings are occupied.
6. In testing ventilating plants in the future, the following should be recorded in addition to the data contained in the above tests:
   a. Temperature of the entering air at the inlet.
   b. Temperature of the air leaving at the outlet.
   c. Weather conditions out-of-doors, especially in their bearing on dust and bacteria.

Thus, if it is raining or snowing, or has recently done so, we may expect less dust in the building, both foot-carried, and air-carried.

Army Hospital Heating

Undoubtedly many of our readers have been watching the progress that is being made in connection with the heating of the various army cantonments and hospitals.

It has been noticed that in some cases stoves have been installed as heaters for this work. Government officials, as well as many heating engineers have gone on record as stating that this type of heating is not suitable for such work, and was only used on account of the unavoidable delay which would have been necessary if an up-to-date steam heating system had been installed in the different camps and hospitals.

As a general proposition, steam heating for this work is much preferable to furnace or stove heating, but in this case the element of time was the deciding factor. Many articles have been written on this subject with practically all of them in favor of steam heating from a central plant, with standard type of cast-iron wall radiation being used in the different buildings. Naturally the piping arrangements would have to be adapted to the local conditions.

It is becoming more evident each day that these cantonments and hospitals cannot be considered as a temporary proposition, but undoubtedly will continue to be used, probably for years longer than was first anticipated; the cantonments as permanent training quarters, and the hospitals to care for those injured during training or in duty overseas. It is, therefore, of great importance that the makeshift system of stove and furnace heating should be replaced as early as possible with an adequate system of steam heating.

Many of the Government officials in Washington have been watching carefully the progress that is being made, and the type of the heating system which is being installed at the Walter Reed Army Hospital, Washington, D. C. If a person who, a few months ago had visited the Walter Reed Hospital, and had occasion to go there since, were to visit that place today he would be somewhat amazed at the sight of the once spacious and beautiful grounds now literally covered with new buildings. His first impression would be that the Hospital had been turned into some kind of industrial or manufacturing establishment, for the many groups of new buildings and the central heating plant with its immense brick chimney more than 150 ft. high, would indicate such to be the case. However, this is not a manufacturing proposition. These buildings have been erected for the sole purpose of housing and treating ill and disabled soldiers.

These buildings, while being considered as temporary, are of standard frame construction. The outside walls are clapboarded, with layers of paper beneath, and the inside walls are arranged with composition wall board, which makes a very neat and attractive structure. When completed there will be a total of at least eighty buildings.

The design and construction of these new buildings was directly under the charge of Col. George F. Downey, Depot Quartermaster at Washington. Nothing has been left undone to make this hospital complete in every respect, and more or less of a permanent nature, not forgetting for a moment to take care of every detail for the most expert and up-to-date treatment of injured soldiers, as well as for their personal comfort, and while every necessary item has been taken care of, yet the total cost of construction and equipment in this group of hospital buildings is stated to be considerably less than the cost of similar buildings in connection with army cantonment camps.

TYPE OF HEATING USED.

It will be of particular interest to note the type of heating which is being installed in this group of buildings. The steam for the heating of this group of hospital buildings is generated at a central power station, which is equipped with eight 150 H.P. horizontal return tubular boilers, each fitted with Long duplex shaking grates and the necessary auxiliaries such as feed-water heaters, boiler-feed pumps, vacuum pumps, etc.

From this central power station extends an underground tunnel which is 6 ft. wide, 6 ft. high and some 2000 ft. in length. In other words, this tunnel extends from the boiler house to a central point which is used as a distributing center for the different pipe lines to the several buildings. The pipe lines from the tunnel to the separate buildings are run in split tile pipe. A pressure of 100 lbs. per square inch is carried on the boilers. This pressure is to maintain a reserve supply of steam and to operate a large laundry, which is to be erected in the near future, and will be steam driven.

Just before leaving the power house, the steam pressure is reduced to 50 lbs., which pressure is carried on the different heating supply mains to the several buildings. Each separate building has its own reducing valve, the pressure being reduced from 50 lbs. to 1 lb. in the building, which pressure is carried on the radiation. Just before this pressure is reduced in the building, connections are taken off the steam supply for an individual domestic water heater, with which each building is equipped. This heater naturally supplies hot water for bathing, cleaning, etc.

The radiation in the buildings consists of wall radiators placed on the outside walls on brackets, thereby taking up very little space, and leaving the floor free for cleaning.

Condensation from the radiators is returned to the heaters in the boiler house through a separate return main. The condensation from the hot-water heaters in the different buildings is also returned to the boiler house separately, and discharged into the feed-water heaters. It might be well to mention at this time that each of the domestic water heaters in the different buildings is automatically controlled by means of sylphon tank regulators. This naturally means an even and safe temperature of hot water at all times.

It can be seen at a glance that the matter of efficiency and economy of operation has been carefully worked out by the engineers in charge of this work, and no condensation of any nature is wasted, everything being returned to the boiler plant to be used again.

The high-pressure steam mains both in the boiler-house and in the tunnel are covered with 85% magnesia pipe covering, the pipe in the tile conduits with two thicknesses of 1-in. air-cell covering, broken joint method, specially treated to withstand moisture. The exposed piping in the buildings is covered with two thicknesses of 1-in. air-cell covering.

When it was first proposed to erect these buildings, there was much discussion as to the best and most efficient method of heating them. It was finally decided to install the Webster vacuum system, and the contract for this was awarded to the Power Efficiency Corporation, of Buffalo, N. Y., who engineered and designed the heating system, the power plant and the building with its equipment, and whose construction department has built the power plant and installed the different apparatus in connection with the entire heating system. The foregoing data is furnished through the courtesy of William G. Fraser, general manager of the corporation.

The engineers had in mind the permanency of construction as well as efficiency in operation, and no material of any description has been placed in this work that is not of standard make, and cannot be used again, should these buildings eventually be discontinued.

It can readily be seen that this is not what is termed a "two- or three-year installation," but rather one which will be good for any number of years should occasion require.

It probably will be interesting to know that in addition to the efficiency of the installation, the matter of safety has also been taken care of. All the high-pressure piping in the boiler-house is fitted with Van Stone joints and pipe bends, as far as possible, these being used in preference to fittings. This naturally reduces the number of joints and the possibility of leakage. Also, each boiler is fitted with an automatic stop and check valve, and all feed piping in connection with the boilers is of brass from the boilers to the control valves. There is also installed in the boiler house two vacuum pumps, each having a capacity of 100,000 sq. ft. of radiation, and three brass-fitted boiler-feed pumps, each with a capacity of 500 H. P. There are also two 500 H. P. Webster open-type feed-water heaters, and all water of condensation from different sources passes through either one or both of these heaters before being again pumped into the boilers. Both the vacuum pumps and the boiler-feed pumps are equipped with pump governors. Each boiler is fitted with twin safety valves and also twin blowoff cocks, owing to the nature of the feed water available.

It was necessary to install surface blowoffs on each boiler, also brass piping in connection with the water columns.

Suitable concrete and steel coal vaults have been provided with a storage capacity of at least 4000 tons.

CENTRAL STATION HEATING

Steam Heating in Salt Lake City

BY H. M. FERGUSON

Since the Utah Power and Light Company entered the steam heating field in Salt Lake City, in 1916, some remarkable progress has been made in the development of central station heating in that city. This company took over the plant of the Hotel Utah Company, also known as the Church plant, which took care of the Hotel Utah, the Temple, Tabernacle and a number of other buildings in that vicinity.

A year later, in April, 1917, the company acquired the Newhouse plant which was furnishing heat to a dozen buildings, including the Newhouse Hotel, Boston Building, Newhouse Building and Commercial Club. For some years there has been some central heating carried on from a plant at the rear of the company's West Temple Office Building, this being the boiler plant formerly used by the traction company.

Towards the close of 1917 the company's plans for heating the business district of Salt Lake City took definite shape. It was decided to install a 20-in. main on South Temple Street and from that line run other lines large enough to heat eventually the district bounded on the north by South Temple, on the south by Fourth South and extending east and west from West Temple to State Street. The southern ends of these lines, it is contemplated, will eventually be connected by a line extending east and west from West Temple to State Street. Provision is also made for a line on Second South Street, extending east and west, for the purpose of tying together the various north and south feeders, for balancing purposes when the distribution system has grown to such proportions as to require such a line.

During the past summer there was installed a 14-in. line connecting the South Temple plant through a tunnel across the Temple grounds to the beginning of the 20-in. main. This feeder will be operated with sufficient initial pressure at the boiler room to deliver 5 lbs. pressure to the distributing system proper, making use of high drop in pressure to obtain sufficient velocity to move through the 14-in. line the required amount of steam. The regulating valve is in the boiler room and is controlled by a small pipe connected with the 20-in. main on South Temple Street. As the pressure fluctuates in the distributing system the pressure in this small pipe actuates this valve and maintains contant distributing pressure.

The same principle is made use of in the 6-in. connection between the West Temple boiler room and the 16-in. line recently installed at the rear of the Kearns Building. It is estimated that from 5 to 50 lbs. pressure will be carried at the plants.

WIDE STREETS A PROBLEM IN ARRANGING FOR SERVICE CONNECTIONS.

In attempting to arrive at the best method of serving the district there were a number of schemes proposed, but all these had to meet the problem of wide streets and large blocks without any regular system of alleys. The ideal district for steam heating, also true with other utilities, calls for a regular system of alleys at the rear of the buildings, making possible short service connections and, in the case of steam heating particularly, an entrance into the building at or near the point where the central system must be connected to the house system.

The width of the Salt Lake streets would make it almost imperative to lay two mains on each street, as near the curbs as possible. The advantage of this construction was appreciated by the city in the laying of its sewer and water mains and also by the electric and gas companies. Consequently we could find no location closer than a point mid-way between the curbs and the car tracks. This would call for the installation of service pipes crossing the construction of the other public services which is particularly difficult on account of the grading of the steam lines for the purpose of handling the water of condensation, making it necessary to locate our mains at an excessive depth in order to get an up-grade from the main to the point of delivery inside the basement.

MAINS LOCATED ON PRIVATE GROUND.

As a result of the above study it was determined to locate mains on private ground as near as possible the rear of the large buildings facing the principal streets.

Our work for this year included a main running through the two blocks on the west side of Main street between South Temple and Second South. This piece of work is completed and operating and leads us to believe that we will be able to continue the same general line of construction until the congested business district is served. This work naturally involves many special conditions such as running through buildings, under basement floors, etc.

COST COMPARES FAVORABLY WITH OPEN STREET WORK.

The cost of this style of construction will compare very favorably with open street work and will have in its favor a very small cost for service connections, both to ourselves and to our customers.

One very pleasant feature of the work during the past summer was the obtaining of right-of-way over private ground, the owners of buildings being very willing to grant us any reasonable privilege in the interest of central heating as against heating from a large number of small boilers which besides increasing dirt, add very materially to fire hazard in the business district.

The type of underground construction used so far consists of wrought-iron pipe for carrying the steam, this surrounded by a wooden envelope from 4 to 5 ins. in thickness. The pipe is first wrapped with asbestos paper securely wired on, and surrounding this is 1-in. dead air space between the wood casing and the pipe. The insulating covering is lined with tin.

Except where very porous gravel was encountered, tile under-drainage was installed. Expansion joints are located about 100 ft. apart, and midway between these joints the line is anchored.

The company is now serving 63 buildings.

THE HEATING AND VENTILATING MAGAZINE

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A. S. ARMAGNAC....................*President*
GUSTAVE PETERSEN....*Secretary and Treasurer*

A. S. ARMAGNAC, Editor
GUSTAVE PETERSEN, Business Manager
HAROLD L. ALT, Contributing Editor

European Representative:
W. G. HOLLINWORTH, 304 High Holborn
London, W. C.

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A NEW type of blackmailer is plying his trade among consulting engineers and, while the manufacturers of building equipment pay the freight, their loss is outweighed by the damage done to the professional character of the engineers involved. The scheme, in brief, is as follows: A solicitor singles out a prominent consulting engineer and offers to print for him, free of cost, a booklet describing in a general way, the classes and types of buildings for which he has recently designed the mechanical equipment, and to furnish him with, say, 1,000 copies. Many of these buildings are illustrated, the whole making a very attractive and impressive document. All that the promotor asks in exchange is the privilege of running advertisements in the booklet.

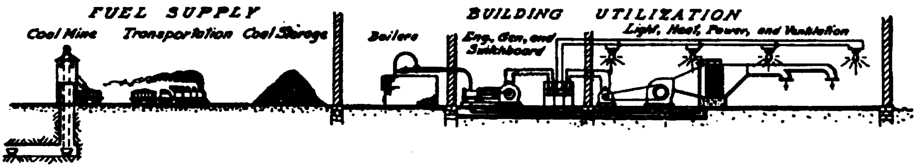
Now for the blackmail. The advertisements, naturally, are to be solicited from the manufacturers whose apparatus has been installed in the buildings illustrated in the booklet, the names of such manufacturers being furnished by the engineer. In some cases the engineer is asked to lend the influence of his name to assist the solicitor. The plan has worked so well for the solicitor that one manufacturer reports having received an average of five letters a week from as many cities, the names of the respective engineers and architects being prominently mentioned. In one case, at least, the proposition was made direct by the engineer himself, who stated, among other things, that "we have decided to carry advertising in amount sufficient to pay for the cost of publication and we are submitting our proposition to those firms only whose product we specify."

Irrespective of the argument that might be made as to whether the advertisers are to receive value for their money, the important point to consider is the moral effect this practice must have on the engineer himself, in lowering his standard of ethics and in its reflection on the profession in general. It is bad business, the character of which has, no doubt, not been realized by most of the engineers involved. Probably it is not necessary to do more than call public attention to the practice to squelch it effectually.

◆

ONE good result of the severity of the past winter is the nation-wide campaign that has been conducted to educate the householder and building manager in the art of managing their heating systems. Hereafter, householders will be more discriminating buyers than formerly, and while it entails an added responsibility on the manufacturer of heating apparatus, it widens very appreciably the field for the sale of high-class heating systems and devices.

POWER PLANT ENGINEERING



Space Requirements for Engines

In laying out a building power plant one of the most vital considerations is that of space. Oftentimes the engine room is an afterthought or a makeshift and the incorporation of the apparatus may be so far controlled by the space conditions as to limit, perhaps, the makes and types of engine permissible to install.

Where an engine room can be laid out to suit the equipment no such limitations exist, but under such conditions space should be allowed to accommodate the units of the greatest dimensions which it is possible to install under the specifications. In either case the overall dimensions are essential in determining the makes and type of apparatus in the first case and the size of room required in the second. It should be noted that it is customary to allow space for one additional unit so as to permit an increase in load in the future, either from the building of a new addition, adding more floors, or by increasing the power-consuming equipment of the building.

For this reason the overall dimensions of a few of the standard makes of machines are presented to give a general idea of the space requirements necessary for a given horsepower, kilowatts and size of engine. It must not be assumed necessarily that all the engines listed herein are instantly available as the war has upset the engine industry most thoroughly. In fact, not only are most units subject to a time of delivery running into many months but others cannot be obtained during the war at all. The return of normal conditions, however, will undoubt-

The American Ball simple engine, referring to Fig. 1, (February issue) has the following dimensions:—

Horse-power	40		60				80		
Kilowatts	25		35				50		
Speed R.P.M.	350 to 400		300 to 325				275 to 300		
Size, inches	8½x8	10x8	9x10	10x10	11x10	12x10	11x11	12x11	13x11
Steam, in. diam.	2½	3	3½	3½	4	4	4	4	4
Exhaust, in. diam.	3½	3½	4	4	4½	4½	4½	4½	5
Length, feet	85¼		101½				109		
Width, feet	81¼		86½				94⅝		
Height, feet	53½		57½				65½		
Weight, lbs.	5050		7250				9200		

(Continued)

Horse-power	120			160			200		
Kilowatts	75			100			125		
Speed R.P.M.	260 to 290			240 to 260			220 to 240		
Size, inches	13x12	14x12	15x12	14x14	15x14	16x14	16x16	17x16	18x16
Steam, in. diam.	4½	4½	5	5	5	6	6	6	6
Exhaust, in. diam.	5	5	6	6	6	7	7	8	8
Length, feet	120			139⅞			149½		
Width, feet	109⅛			114¾			125¼		
Height, feet	71½			78½			84		
Weight, lbs.	12100			16250			19400		

VILTER CORLISS NON-CONDENSING ENGINES

The Vilter Mfg. Co. builds a simple non-condensing Corliss engine of girder-type, the dimensions, referring to Fig. 2, (February issue) being as follows:

Size In.	RPM	*H.P.	Length	Width	Height	Steam. In. Diam	Exhaust, In. Diam.
9 x 24	100	50	15'-0"	6'-7½"	5'-8"	2½	2
10 x 24	100	61	15'-8"	7'-7"	6'-6"	2½	3
10 x 30	100	77	18'-0"	7'-0"	6'-6"	3	3½
12 x 30	100	110	18'-4"	8'-0"	6'-11"	3½	4
13 x 30	100	130	18'-4"	8'-0¾"	6'-11"	3½	4
14 x 30	100	150	18'-10"	8'-2¼"	7'-5"	4	4½
15 x 30	100	173	19'-0"	8'-9½"	7'-5"	4½	5
16 x 30	100	197	19'-0"	8'-9½"	7'-5"	4½	5
12 x 36	100	133	20'-10"	8'-1½"	7'-5"	3½	4
14 x 36	100	180	20'-10"	8'-9½"	7'-5"	4	4½
15 x 36	100	207	20'-10"	8'-9½"	7'-5"	4½	5

*Horsepower given for 100 lbs. steam pressure and one-third cutoff.

Note:—These dimensions do not include the generator.

BUFFALO HORIZONTAL SIDE CRANK ENGINES

The Buffalo Forge Co. makes the following line of horizontal side-crank engines for high pressure.

H. P.	20	45			65			95		
Kw.	10	20			35			50		
Speed, R. P. M.	450	400			350			300		
Size, In.	6 x 6	6 x 8	8 x 8	10 x 8	8 x 10	10 x 10	12 x 10	10 x 12	12 x 12	13 x 12
Steam In. Diam.	2	2	2½	3	2½	3	3½	3½	4	4
Exhaust In Diam	2¼	2½	3	3½	3	3½	4	4	5	5
Length, In.	66	76			89			110		
Width, In.	42	48			56			64		
Height, In.	44	47			53			62		
Weight, Lbs.	500	620			1200			1850		

STURTEVANT HIGH-SPEED ENGINES

The B. F. Sturtevant Co. makes a simple high-speed engine of the following dimensions:

Steam pressure lbs. gauge	80	40	35	120	80	120	80
Kw.	20			30		40	
Speed, R. P. M.	375	250	250	350		300	
Size, In.	8x8	15x8	15x10	8x10	10x10	10x10	11x10
Steam In. Diam.	2½	3	3	2½	3½	3	3½
Exhaust In. Diam.	3	3½	3½	3	4	3½	4
Length, in.	77¼	83½	98½	97¼	97½	102½	102½
Width, in.	64¼	69¼	76¾	75¼	76¾	80¼	80¼
Height, in.	47	50¾	55¼	55¼	55¼	59	59
Weight, lbs.	5000	6000	8600	8000	8300	9200	9400

Steam pressure, lbs. gauge	120	80	120	80	120	80
Kw.	50		60		75	
Speed, R. P. M.	275		275		275	
Size, in.	10x12	13x12	12x12	14x12	12x14	14x14
Steam, In. Diam.	3	4	4	5	4	5
Exhaust, In. Diam.	3½	4½	4½	6	5	6
Length, in.	117¼	118¼	118	121¼	134½	135
Width, in.	99¾	100¾	100¾	100¾	111	111
Height, in.	69	69	69	69	75½	75½
Weight, lbs.	14250	15000	14750	15200	19300	19800

Steam pressure, lbs. gauge	120	80	125	100	125	100
Kw.	100		125		150	
Speed, R. P. M.	250		250		250	
Size, in.	14x14	16x14	14x16	16x16	16x16	18x16
Steam In. Diam.	5	5	5	6	6	6
Exhaust, In. Diam.	6	6	6	7	7	7
Length, in.	138¼	141	154½	153	15¾	159¼
Width, in.	112¾	112¾	120	120	131½	131½
Height, in.	78	78	82	82	84	84
Weight, lbs.	24000	24000	30500	30750	33500	33700

edly place these engines again on the market for the benefit of the individual customer.

Engines must be supplied with the following equipment to meet the U. S. Government specifications:

(*a*) Re-throttle valve for starting and stopping the unit.

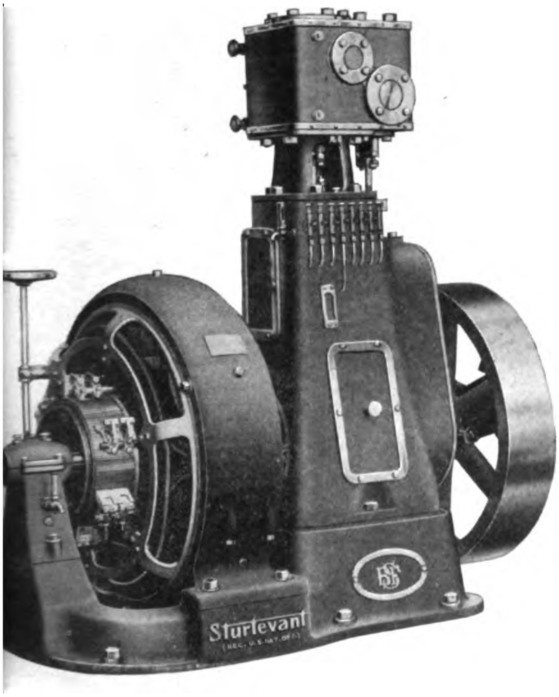
(*b*) Automatic cylinder relief and drain valve.

(*c*) Cylinder lubricator with piping, etc.

(*d*) Metal packing for piston rods and valve-stem stuffing boxes.

(*e*) Auxiliary hand oil-pump.

(*f*) Steam chest drain connections with valves.



STURTEVANT SIMPLE HIGH-SPEED ENGINE.

(*g*) Indicator piping with threeway cocks and angle globe-valve.

(*h*) Attached indicator reducing motion.

(*i*) Adjusting wrenches mounted on hardwood panel.

(*j*) All necessary drip, drain and indicator piping of nickel-plated brass pipe above the floor.

After erection the engines and generators should be rubbed smooth, painted two coats of very dark green (or else a dark maroon or wine red) paint and striped with gold leaf after which varnish should be applied.

Almost every engine can be obtained either "right-hand" or "left-hand," as shown in Fig. 2. The easiest hand to obtain is the right-hand, all engines being built or carried in stock in this hand; left-hand engines are sometimes, but not always carried in stock. For this reason it is preferable to use "right-hand" engines where all other conditions are equally suitable to either hand. The distinction between a "right-hand" and "left-hand" apparatus is determined by standing at the cylinder and looking toward the shaft; if the eccentric is on the right-hand side of the piston rod the engine is "right-hand" while if it is on the left-hand side the engine is "left-hand."

It is also desirable that the engine should "run over" rather than "run under" owing to there being less liability to knock, due to the centrifugal force of the crank and connecting rod. By "running over" is meant that when standing at the cylinder and looking toward the shaft the crank at the top portion of its revolution is receding from the observer while, if running under, the crank during the top portion of its revolution is approaching the observer.

One of the greatest helps to successful engine operation is the providing of a sufficiently heavy foundation to absorb the thrust of the reciprocating and unbalanced parts. Engines and other vibrating machinery may be supported on comparatively unstable framing if a foundation of sufficient mass is provided to properly absorb the vibration. As a general thing a foundation from 3 to 4 ft. thick on a 100 Kw. engine up to 7 to 10 ft. thick on a 1,000 Kw. engine will be found amply massive for this purpose.

A good test of the proper balancing of an engine and a proper steadiness of running can be made by standing a coin on edge on the top of the cylinder or other portion of the machine. If the coin remains standing the engine has but little vibration but if it falls over repeatedly the engine is either out of adjustment or the foundation is too light. Needless to say, the test coin used should be a comparatively new one on which the corners have not become excessively rounded.

Notes

Broken parts of the power-plant—particularly crankshifts—have been becoming increasingly difficult to deal with owing to slow delivery of new shafts and the almost impossibility of finding any spare shafts in stock. That the old shafts can be repaired as good as new, however, is the encouraging claim made by the Goldschmidt Thermit Co., of New York, which has made many such repairs. The company states that it has never yet heard of a thermit weld breaking under regular service conditions.

A grease and oil interceptor is shown herewith, this being a simple device for catching and retining oil and grease carried out of the plant in the "dirty drip" discharge. It also has the added advantage of keeping this undesirable element out of the sewer. The oil and grease floating on the surface are prevented from reaching the outlet by the baffle, while scale, dirt and other "heavier than water" substances are retained in the bottom of the first compartment by the dam. A removable cover gives access to the interior for removing the oil and grease and to clean out the material retained behind the dam.

For overloaded boilers the period of fire cleaning sometimes comes at very inopportune times. The Thomas Grate Bar Co., Birmingham, Ala., advocates the use of their "wiggling-shaking-dumping" grate bars by means of which the cleaning period is not only eliminated but the fires are kept in the very best possible condition at all times. The opening of furnace doors for slicing, cleaning, etc. is also avoided.

LEGAL DECISIONS

Heating and Humidifying Air Patent.

In a suit for infringement of a patent (Carrier patent No. 854,270) for a method of heating and humidifying air. The federal district court for the Western District of New York holds that a patent for a method cannot be sustained when it appears that the result achieved is due to the operation of a machine; but when the new result comes from certain acts, or a series of steps, irrespective of mechanism or the mechanical assemblage, then the steps taken, or the acts performed, or the method of treatment involve patentable invention. The court held the patent in question valid, irrespective of any automatic regulation of the temperature and humidity of the air by the aid of a thermostat or other mechanical instrumentality, inasmuch as the process was not entirely dependent upon the use of a thermostat; the performance of its function being due to the use of water at a temperature higher than that of the air and below the boiling point, which was first caused to contact intimately with a current of air into which the heated water was sprayed. Such steps increased the temperature of the air, which then vaporized or assimilated the moisture, the relative humidity of the air depending upon the temperature of the air. The thermostat was arranged to come within the influence of the heated and humidified air, and while in that condition operated to maintain the water at a proper temperature to increase the temperature of the air to the point of saturization, or to what is known as dew point, meaning a degree of temperature having a certain amount of humidity below which it cannot be reduced without first condensing the moisture content from the air. The intimate contact of the air with the water is brought about by the action of a pump, which draws the warm water after circulation through the apparatus into a well, the warm water then flowing through a bypass piping for regulation by the thermostat placed in the room in which the humidity is to be controlled. As the patentee's invention was a departure from prior processes, the claims of his patent were held entitled to a fairly reasonable construction, which will not permit another, by changes of form only, to appropriate the substance of his invention. *Buffalo Forge Co.* v. *City of Buffalo,* 246 Fed., 135.

Independent Contractor.

In an action for personal injuries it appeared that the defendant engaged an independent contractor to construct a concrete building. The plans and specifications were adequate and skillfully drawn. The building having been completed the defendant engaged another independent contractor to install the plumbing and heating apparatus. The plaintiff, an employee of a subcontractor of the latter, was injured while doing plumbing work by the collapse of the building. The building, which was of reinforced concrete work, was constructed in early winter. At that time the work was not inherently dangerous, as proper steps could be taken to prevent the freezing of the concrete. It was held that the plaintiff could not recover merely because of the fall of the buiulding, without proof of the defendant's negligence, on the theory of *res ipsa loquitur,* the defense that the work was being done by an independent contractor being available to the defendant. *Looney* v. *Prest-O-Lite Co.,* Indiana Appellate Court, 117 N. E., 678.

The War and the Heating Engineer

New Food Card for 1918

The programme set forth by the United States Food Administration for 1918 is as follows:

Two wheatless days (Monday and Wednesday) in every week, and one wheatless meal every day.

One meatless day (Tuesday) in every week and one meatless meal every day. Also two porkless days (Tuesday and Saturday) every week. As a nation, says the food administration, we eat and waste nearly twice as much meat as we need.

Make every day a fat-saving day. The food administration estimates that we use and waste two and one-half times as much fat as we need.

Make every day a sugar-saving day. Our waste of sugar, says the food administration is about twice the amount needed.

Use fruit, vegetables and potatoes abundantly.

Use milk wisely.

Do not limit the food of growing children, advises the food administration, eat sufficient food to maintain health, and preach and practice the gospel of the "clean plate."

Heatless Monday.

In view of the institution of "Heatless Monday" as a measure apparently designed to save one-seventh of the week's coal supply, may the writer call attention to some features of the subject which are well understood by all practical engineers, but not a subject to which the general public has evidently given attention?

It will be found out later that, instead of one-seventh of the coal being saved, a much smaller saving has actually been realized, due to a number of causes among which is the fact that it is impractical to entirely shut off heat from large buildings on account of the danger to merchandise, the possibility of freezing pipes, and, the extraordinary amount of coal that would have to be used for many hours before occupancy to again bring the temperature back to 70°.

In their patriotic efforts to carry out the government order, engineers have tried to reduce temperatures to about 45° or, say, a saving of 35%, which is not realized for the reason that the walls having attained a degree of high temperature together with the large volume of air, give off their accumulated heat. Consequently it may take, say, eight hours of the twenty-four to realize the required reduction of temperature. It, therefore, becomes questionable if, after adding this heat loss to that lost in extra firing during the twenty-four hours to re-establish the 70° temperature, there accrues any saving whatsoever.

It is also true that in most factories, especially where the work of both heat and power are practically balanced, heat becomes a by-product of power. In other words, power and heat can be made just as cheap as either one alone and in many instances the engineer will substantiate the claim that heating alone costs more per day on holidays and Sundays than on week-days, although reduced as much as is practical to effect economy.

Another circumstance, no doubt typical, consists in turning off heat from all radiators on Saturday evening and indiscriminately turning heat on again on Tuesday when, as a matter of fact, very little additional heat is necessary in some rooms, due to risers passing through them, while in others similarly situated and unoccupied radiators are turned on full. In such instances a clear case of loss exists rather than gain.

Acting on the theory that criticism is an expression of ignorance unless of a constructive character, the writer offers the following suggestions for actual coal saving:

1. Householders to shut off heat entirely from bedrooms and others not in actual use.
2. Reduction of day temperature to 65° and allow the extra underwear properly worn in the winter season to provide the warmth for which it is intended, thereby assisting in the prevention of colds and doctor's bills.
3. The steam-heated flat and business office, which have done so much to

populate our graveyards with consumptives, should also be similarly regulated.

4. Workshops should be reduced from 65° to 60°, depending on the nature of the employment.

Assuming that the above day-temperatures are steadily maintained and a practical and economical reduction of night-temperatures (not to exceed 15°) be also maintained, it then becomes but a simple matter of figures and practical proof that, whereas, under the system of "Heatless Monday"—which should at best but a small and questionable saving of fuel for one day—there is a six-day saving from 12% to 15%, besides the saving to both capital and labor so much needed and attainable by the application of rules which are the result of practical experience.—*W. H. Pearce, Chicago.*

The Blue-Card W. S. S. Pledge.

A marked impetus to the sale of war-savings and thrift stamps has been given by the distribution of blue post-cards order blanks which may be filled out and mailed postage free. The stamps will then be delivered C. O. D. The cards can be obtained in quantities at any post office, bank and from letter-carriers. Special emphasis is laid on the convenience of the blue card for trade agents when ordering supplies.

Already 350,000 war-savings stamp agencies have been established. There will also be 1,000,000 "sales stations." 50,000 post offices now have war-savings stamps on sale and 29,000 banks and 8,000 individual firms and corporations have been appointed agents.

Preparing for the Next Liberty Loan

It is now well-known that the observance of meatless days has not only helped materially to feed our fighters and allies, but has also helped to swell our individual bank rolls. We are richer for this patriotc effort.

"What are you going to do with that extra money?" asks those handling the forthcoming loan, "frivol it away; blow it on some extravagance of which you will soon be ashamed? Or will you salt it away for your own good and that of your country and civilization?" You are confronted with an ideal opportunity of spreading the good effect of your initial patriotism by investing the money you have saved thereby in Liberty Bonds. There are, of course, no better securities than those which the government offers. Very soon the government will be asking you to buy bonds of the third and greatest Liberty Loan. Keep that money you are saving that you may respond to this call in the great American way.

Louisville as a Manufacturing Center

Louisville, Ky., has the distinction of possessing electric power for industries in excess of its present demands. During the past winter this excess has been about 10,000 k. w. This condition is largely due to the fact that the central station owns the mine from which it draws its coal supply and owns its coal cars. Its coal mine is a night's run from Louisville, assuring a plentiful supply of fuel and continuity of electric power.

The movement of residents to suburban districts has also made available in Louisville several thousand modern dwellings at moderate rentals which are said to be especially suited to the living requirements of labor. The foregoing facts are being featured by the Louisville Industrial Foundation for the benefit primarily of manufacturers of war materials.

Heating Men in Military Service.

Four of the heating superintendents of Hopendyl, Hardy & Co., New York, which operate a number of central station heating plants in the Middle West, are now in the service of the government.

F. W. Gano, who was originally located at the company's plant in Peoria, was the first to enter the service. He is now an artillery officer, with the rank of second lieutenant.

R. V. Stureman, of Springfield, Ill., entered the service as sergeant in the Quartermaster's Corps, was afterwards recommended to a second lieutenancy in the Engineers' Corps and has recently been appointed first lieutenant in the same corps. He is now in Houston, Texas.

F. E. Thompson, of Evansville, entered the second Officers' Training Camp at Fort Benjamin Harrison, Indianapolis,

Come on, Men, 250,000 of You!

SHIPYARD U-S VOLUNTEER

This is Your Badge of Honor
Wear It Proudly

Launch a Blow at the Kaiser by Helping Launch a Ship

The Man of the Hour.

Who says we can't build ships?

Come on, you loyal American Mechanics, masters of familiar trades, and brand this "made in Germany" insinuation by building a bridge of ships to Pershing.

This does not mean that you are to give up your regular job and rush off to some shipyard which at the moment, may not be able to accommodate you. Quite the contrary! Your enrollment simply shows that you stand ready, when called upon, to do a particular job for a particular wage in a particular place. Everything will be in readiness for you, and you will loose no time.

Ships are not things of mystery; they are merely big buildings afloat—the product of everyday skill and industry—and the American Mechanic (hats off to him) can build them.

Where can YOU qualify in the following list?

- Acetylene and electrical welders
- Asbestos workers
- Blacksmiths
- Anglesmiths
- Drop-forge men
- Flange turners
- Furnace men
- Boiler makers
- Riveters
- Reamers
- Carpenters
- Ship carpenters
- Dock Builders
- Chippers and calkers
- Electrical workers
- Electricians
- Wiremen
- Crane operators
- Foundry workers
- Laborers, all kinds
- Loftsmen
- Template makers
- Machinists and machine hands, all sorts
- Helpers
- Painters
- Plumbers and pipe fitters
- Sheet-metal workers
- Coppersmiths
- Shipfitters
- Structural iron workers
- Riveters
- Erectors
- Bolters up
- Other trades
- Cementers
- Crane men

CLIP THE COUPON AND GET THE FULL STORY

Edward N. Hurley, Chairman,
U. S. Shipping Board,
Washington, D. C.

I wish you would send me at once further information, telling me how I can enroll as a member of the U. S. Shipyard Volunteers of the Public Service Reserve for employment in shipyards and so help win the war.

My Trade is ....

My Name is ....

Street Address ....

Town .... State ....

and was afterwards transferred to Fortress Monroe, where he received a commission as second lieutenant in the Coast Artillery. He was one of 300 of this camp who volunteered to go to France immediately and is now "somewhere in France."

B. A. Lowe, who was originally superintendent of the heating department in Springfield, O., and was tranferred to Evansville to take Mr. Thompson's place when he entered the service, is now in the third Officers' Training Camp at Chillicothe, O.

W. G. Boales, of the New York office of the Hoffman Specialty Co., Chicago, has been appointed inspector of shells. He is at present located at Jefferson Barracks, St. Louis, and expects to be transferred soon to France.

H. L. Whitelaw of the American Radiator Co., Chicago, Ill., is now a second lieutenant in the Royal Flying Squadron, of Canada.

Benjamin Nelson, of the Chicago office of Warren Webster & Co., Camden, N. J., has been commissioned first lieutenant in the Ordnance Reserve Corps. He is stationed at Springfield, Mass.

Richard S. Bull, of Chicago, a member of the Illinois Chapter of the heating engineers' society, has been commissioned a captain of field artillery. He is stationed at Rockford, Ill.

To Promote Dehydration.

A resolution urging the Government to use dehydrated vegetables in the army and navy ration was passed recently by the Woman's Committee of the California Council of National Defense. It is believed that dehydration will make it possible to save surplus farm products in California which might otherwise go to waste; that there would be a saving in bulk and cost over canned goods; that government orders for dehydrated products would encourage the establishment of a healthy dehydrating industry; that the use of these products by the army and navy would assist in bringing them before the general public. The resolution reminds our Government that the British, French, and German armies are now using enormous quantities of dehydrated vegetables with satisfactory results, and that a Canadian firm is supplying 2,000,000 lbs. monthly of dehydrated vegetables to the French and British armies.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Organization of the Council.

The new council of the heating engineers' society has organized as follows: executive committee: W. H. Timmis, Homer Addams and J. I. Lyle; publication committee, Champlain L. Riley, E. Vernon Hill and F. G. Phegley; finance committee, Homer Addams, W. H. Driscoll and H. P. Gant; membership committee, Howard Fielding, C. W. Kimball and F. W. Powers. At the organization meeting a special vote of thanks was accorded Secretary C. W. Obert who was reelected.

Illinois Chapter Holds War Session.

"Engineering Problems at the Front," and "Constructive Dectective Work at Home" were the subjects of two addresses delivered before the Illinois Chapter of the heating engineers' society at its January meeting, held at the Engineers' Club, Chicago, January 14. The speakers, both of whom were secured by J. F. Tuttle, were Sergeant B. S. Wolf, of the Thirteenth Engineers, who has seen service in France where he was wounded and who was on the torpedoed steamship Finland, and Hinton C. Clabaugh, superintendent of the Federal Department of Justice, at Chicago.

The speakers were introduced by Mr. Tuttle, President E. Vernon Hill relinquishing the chair for this purpose.

Sergeant Wolf, who was the first speaker, described the sanitary facilities provided for the troops at the front, the members being especially interested in the provisions made for hot-water shower baths. He told of his journey across the Atlantic, the reception of his regiment in England, where it was given a luncheon in Windsor Gardens, adjoining Buckingham Palace, after being reviewed by the king and queen. Sergeant Wolf confirmed the stories of the capture of young German prisoners and of the growth of internal troubles in Germany. He concluded with an account of the torpedoing of the Finland. He stated that he was in the water several hours clinging to a piece of wreckage and was finally picked up by a passing vessel in an unconscious condition.

Mr. Clabaugh, the second speaker, gave

an equally interesting address on the work of his department which has to do with the detection of disloyalty to the United States. He said there were many amazing cases of disloyalty and gave details of a number of typical cases. He also paid high tribute to the great numbers of citizens who have co-operated with his department in the apprehension of alien enemies.

At the conclusion of his address a rising vote of thanks was accorded both speakers.

In order to further the work of fuel conservation, a motion was passed that a committee of three be appointed to devise plans to this end. The personnel of this committee and the set of rules and suggestions later drawn up are presented in another column.

The subject for the February meeting was "The Relation of the Medical Profession to the Heating and Ventilating Engineer," the speaker being Dr. W. A. Evans, formerly health commissioner of Chicago.

Illinois Chapter Formulates Rules for Handling Boilers.

Considerable publicity is being given to the efforts of the Illinois Chapter to provide the public with directions for handling boilers and warm-air furnaces. These rules have been reproduced in full in two of Chicago's daily papers. They are not intended for large consumers, but for householders and not for apartment house janitors, but for laymen who know little of the science of coal saving.

The suggestions were compiled by a committee consisting of J. F. Tuttle, chairman; James H. Davis and Charles G. Lamb and are presented in such a way that they may be cut out and pasted on a card for reference. Following are the rules in full:

SOFT COAL

1. Thoroughly clean flues and passages of boiler or furnaces at least once a day.
2. Steam boilers should be blown out under pressure to remove grease and dirt. This is very important and should be done at once by an experienced man. Hot water plants should have water renewed in full before starting heating season.
3. Clean base of chimney and smoke-pipe once a year.

METHOD OF FIRING

1. Fire often and lightly, keeping grates fully covered.
2. Do not spoil fire by stirring it around or mixing it up.
3. Use slice bar under fire bed on top of grates, lifting only enough to break or crack open the mass. Keep fire free from clinkers.
4. In large boilers or furnaces use the alternate method of firing; first, one-half of grate, and next, firing the other half. This is done to have a bright fire to assist in burning the gases from the coal just fired and to make heat until the fresh coal ignites.
5. Don't smother your fire.
6. Use the smaller prepared sizes of coal if possible. If you cannot get the small coal, break the large coal into small lumps. Wet all soft coal thoroughly before firing.
7. The best way to fire round boilers or furnaces is to get the house warm by firing lightly and often. Then fill fire-pot full of wet coal. Next take a piece of pipe or broomstick and poke a hole down through the fuel-bed to the grate. Carefully withdraw and leave hole in fuel bed. Check off the draft so that it will not burn too rapidly. This hole soon will carry a large blue flame, which is gas driven off from the fresh coal. If this method is followed, the gas will not be lost up the chimney.

ASHES

1. Don't shake grate violently. It wastes coal.
2. Keep ash pit clean.
3. Never allow ashes to get within 6 in. of grate.
4. Remove ashes from last shaking before shaking again.

DRAFT

1. Be sure your chimney is large enough, high enough and absolutely tight.
2. Do not allow any connections to be made to the heating chimney, excepting the heating boiler or furnace alone.
3. Regulation of draft is very important in saving coal and should be attended to at once by an experienced man. If you cannot regulate your draft be sure to call for assistance.
4. The draft to ash pit should not be open any more than necessary to maintain the desired temperature.
5. Do not open ash pit door to increase draft. Use draft damper under grate provided with boiler or furnace for this purpose.
6. Check draft must not be open unless draft damper under grate is closed.

HARD COAL

1. Thoroughly clean flues and passages of boiler or furnaces at least once every week.
2. Steam boilers should be blown out in same manner recommended for soft coal. Also clean base of chimney in same manner.

METHOD OF FIRING

1. In using anthracite coal a bright fire should always be kept if you wish heat. In building up a fire use a small quantity often with good draft until the fire pot is full to the center of fire door. Draft then can be checked to hold the heat desired.
2. A hard coal fire should never be disturbed by stirring or breaking up with a poker.
3. Remove clinkers, if any, through grate or clinker door.
4. Use size of coal recommended by maker of boiler or furnace. Don't wet hard coal.

ASHES

Rules same as for soft coal.

DRAFT

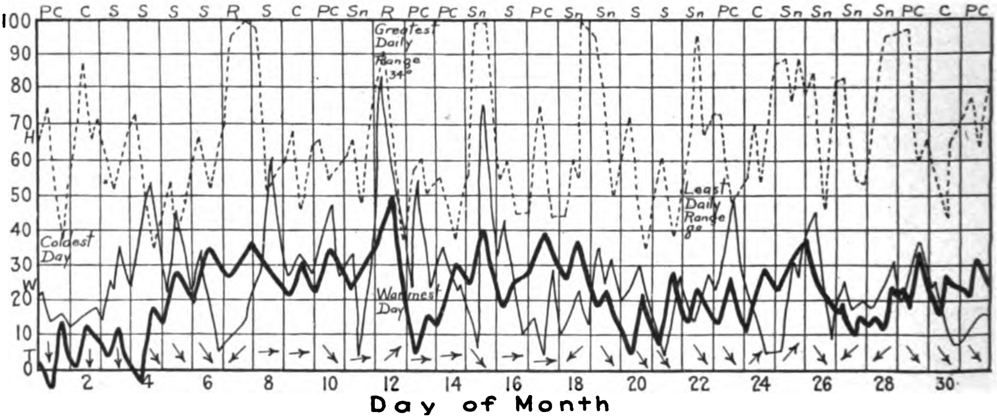
Rules same as for soft coal.

GENERAL REMARKS

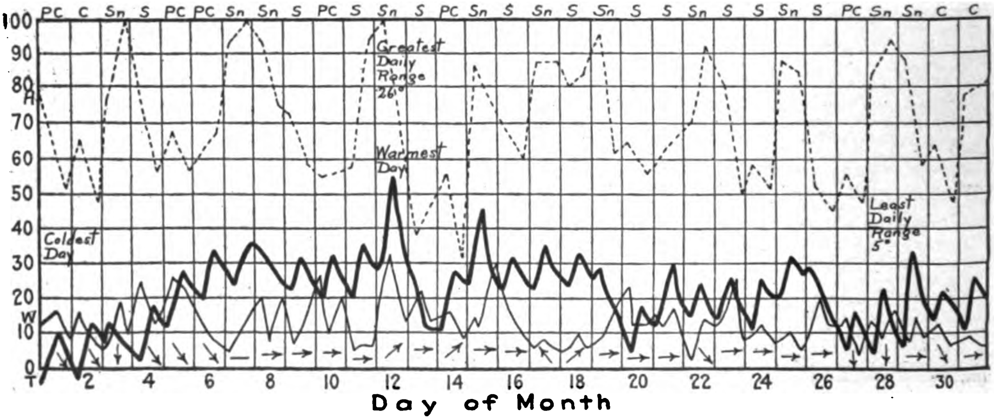
1. Cover boiler and pipes with asbestos or other insulation; also weather strip your windows and doors or stuff cracks with cotton.
2. Keep your room at 68° F. (best heat for health.)
3. Heat only the rooms you use all the time.
4. Close bedroom doors when windows are open and shut off radiator.
5. When any room is kept at a lower temperature than balance of rooms keep door closed.
6. Protect a hot-water radiator in room when windows are open by throwing a blanket or rug over radiator. Radiator may then be shut off without fear of freezing.
7. Use hot water sparingly, as every gallon of hot water wasted means loss of coal.

The Weather for January, 1918

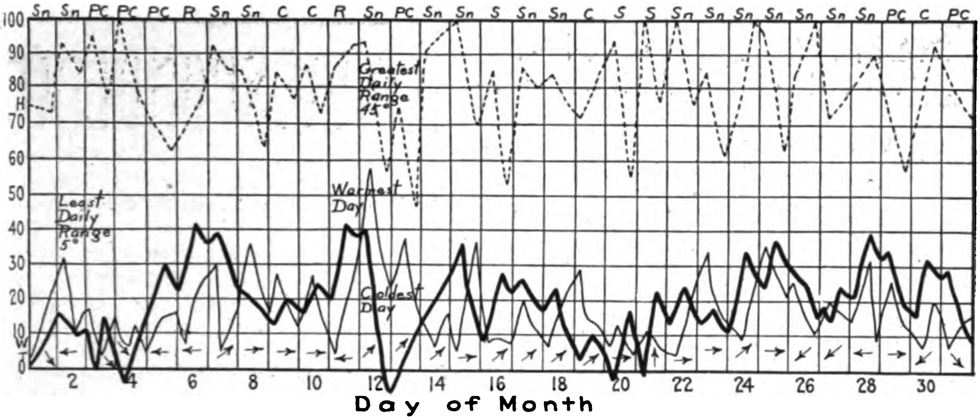
	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest temperature, degrees F.	50	54	41	35	45
Date of highest temperature	12	12	11	25	25
Lowest temperature, degrees F.	−5	−3	−5	−14	−17
Date of lowest temperature	1	1	12	12	12
Greatest daily range, degrees F.	34	26	45	26	29
Date of greatest daily range	12	12	12	23	11
Least daily range, degrees F.	8	5	5	5	4
Date of least daily range	22	28	2	2	27
Mean temp. for month, degrees F.	21.6	21	19	13.3	18.8
Normal mean temp. for month, deg. F.	30.2	27	30.7	23.7	31
Total rainfall, in.	3.41	3.11	2.82	4.12	1.31
Total snowfall, in.	13.6	13.8	19	42.5	11.7
Normal precipitation, this month, in.	3.79	3.82	2.87	2.00	2.27
Total wind movement, miles	15057	8955	9878	10699	10336
Average hourly wind velocity, miles	20.2	12	13.3	14.4	13.9
Prevailing direction of wind	N. W.	W.	S. W.	W.	N. W.
Number of clear days	8	11	4	9	6
Number of partly cloudy days	10	8	6	7	13
Number of cloudy days	13	12	21	15	12
Number of days on which rain fell	5	1	2	..	1
Number of days on which snow fell	9	11	15	15	8
Snow on ground at end of month, in.	4.6	4.6	7.2	23.8	0.7



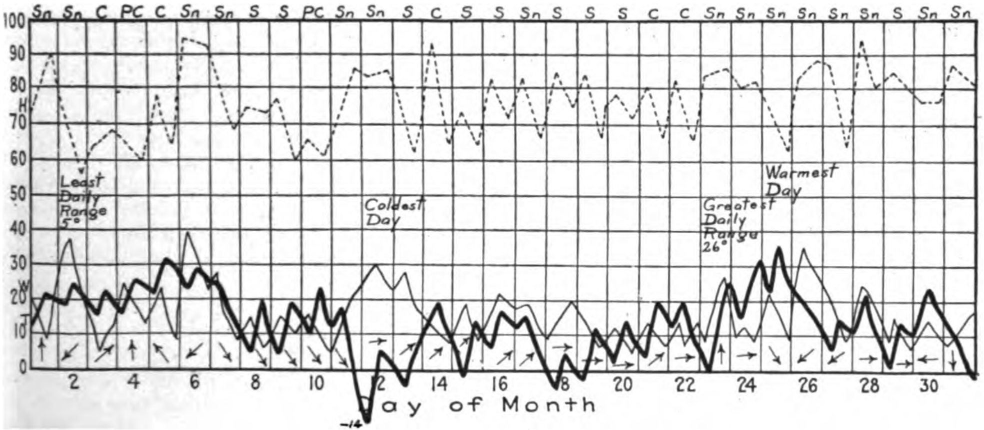
RECORD OF WEATHER IN NEW YORK FOR JANUARY, 1918.
(Hourly observations of the Relative Humidity are Recorded on this chart)



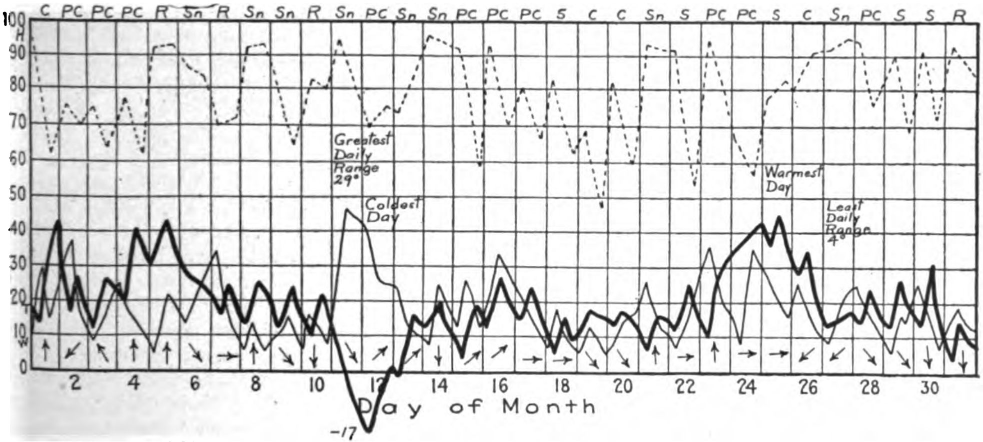
RECORD OF THE WEATHER IN BOSTON FOR JANUARY, 1918.



RECORD OF THE WEATHER IN PITTSBURGH FOR JANUARY, 1918.



RECORD OF THE WEATHER IN CHICAGO FOR JANUARY, 1918.



RECORD OF THE WEATHER IN ST. LOUIS FOR JANUARY, 1918.

Plotted from records especially compiled for The Heating and Ventilating Magazine, by the United States Weather Bureau.

Heavy lines indicate temperature in degrees F.

Light lines indicate wind in miles per hour.

Broken lines indicate relative humidity in percentage from readings taken at 8 A. M. and 8 P. M.

S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.

Arrows fly with prevailing direction of wind.

NATIONAL DISTRICT HEATING ASSOCIATION

Data Wanted on Underground Construction Troubles.

Difficulties experienced with underground construction for pipe lines and the methods taken to overcome them, are being investigated by the Underground Construction Committee of the National District Heating Association. Manholes surrounding fittings in the heating mains, particularly high-pressure steam mains, says the committee, are one of the greatest sources of heat loss. This heat loss is concentrated in the manhole head which is in direct contact with the pavement.

The damage to pavements, particularly asphalt, is a continual cause of complaint from the city highway departments and the property owners. Sunken pavements around manhole heads are also a continual source of damage claims as well as a continual source of expense, due to repaving charges.

In order to get information on this subject the committee is sending out a list of questions, as follows:

A. What class of mains do you operate?
  High-pressure steam?
  Low-pressure steam?
  Hot water?
    (Give operating pressure).
B. What type of manhole do you use?
  Concrete?
  Brick?
  Cast-iron sectional?
C. How do you insulate the fittings in your manholes?
  (Give details).
D. Do you have trouble with pavement around manhole heads?
  What kind of payments?
    (Describe trouble and state inside temperature manhole when closed.)
E. What valves, traps, fittings, expansion joints, or specials in manhole?
F. Do you pave around manhole head in special manner?
    (Give details and sketch).
G. What have you done to overcome heat losses at manholes?
H. What suggestions have you to offer regarding construction of manholes, such as insulating sidewalks, etc.?
    (Give details and sketch).
I. What suggestions have you to offer regarding special insulation of fittings in manhole?
    (Give details).

The chairman of the committee is H. A. Austin. 280 Madison Avenue, New York.

CORRESPONDENCE

Heat Loss and Leakage Loss Factors.

EDITOR HEATING AND VENTILATING MAGAZINE:

Commenting on your heating charts which you are publishing each issue, I would like you to publish the loss factors for metal sash, both for double-hung windows, for the fenestra style, for solid sash and the kind with the pivoted movable centre section, also the loss per degree difference for constructions such as are being used in the present army cantonments.

Another important building construction that you have apparently not covered, is the asbestos shingles, both for roofs and side walls. A great deal of this kind of structure is being used at the seashore.

Still another is the rubberoid roofing, which is about ⅛-in. thick. I do not mean the ordinary tar paper. It is also used to make the outside cover on overhead outside mains.

I shall look forward with interest to the publishing of a sheet with these very important factors given.

Philadelphia, Pa. R. G. E.

It is with great pleasure we print the above letter and it is just the sort of comment for which we are looking. The only way we can improve, enlarge and make our Standard Data Sheets of the greatest value is to have them cover items of interest such as our correspondent has pointed out. We hope more of our readers will co-operate with us to the extent of signifying information which they would like to see incorporated in the Standard Data Sheets.

In regard to the metal sash, the loss factors for glass have already been published and the losses for glass in any sort of sash are all alike; what our correspondent probably means is how much shall be allowed for leakage on metal windows of various designs. One of the most authoritative discussions on this subject is contained in the paper on "Window Leakage" presented before the A. S. H. V. E. in 1916 by Stephen F. Voorhees and Henry C. Meyer.

The metal sash tested involved many kinds, the names of the manufacturer being omitted, and the results compared by means of curves. It is stated in this paper that the leakage for metal sash is very variable and a building is cited in which the radiation in all rooms having metal sash was increased 33⅓%

above normal which added amount did not prove to be enough in some cases, while in others it was excessive, showing a great difference between different windows of the same manufacturer and in the same installation.

The results of these tests show that, at an air pressure equivalent to a wind velocity of 100 miles per hour, the *total* leakage of windows under various conditions expressed in cubic feet of air per minute per linear foot of sash perimeter is as follows:

Type of Sash		Cu. Ft. per Min. per Linear Foot Perimeter
Pivoted window "Style A"	plain	1.30
Standard wood window	weatherstripped	2.35
Hollow metal	weatherstripped	4.33
Hollow metal	plain	5.90
Hollow metal	plain	6.30
Hollow metal	weatherstripped	6.80
Hollow metal	weatherstripped	8.33
Pivoted window "Style B"	plain	9.10
Copper covered	plain	9.20
Hollow metal	weatherstripped	11.00
Standard wood window	plain	11.40
Hollow metal	plain	11.50
Hollow metal	plain	12.40
Hollow metal	plain	15.33
Hollow metal	plain	18.95
Hollow metal	plain	19.20

From this it can be seen that the comparative leakage between plain wooden sash and plain hollow metal is 80% greater for hollow metal in the worst case. With good weather-stripping the metal window leakage runs about 100% greater than wooden sash weather-stripped, but with poor weather-stripping it is not impossible for the metal sash to go up five times the leakage of weather-stripped wooden sash.

In the near future an additional sheet on "Leakage" will be issued to cover the subject of metal windows, but owing to the fact the pressure difference of 3.75 in. of water (equal to a wind velocity of 100 miles per hour) could never be maintained in practice, due to the room pressure building up inside and reducing the differential it is probable that the leakage on any sash would not amount to over 50% of that indicated in the test.

The army cantonments for officers training camps (according to W. J. Maurer of the Chicago Department of Health, Ventilation Division, in a paper read before the A. S. H. V. E. last July) are built with ⅞-in. battened sides and roof with the roof covered with roofing felt saturated with asphalt The sides are only carried up to within 3 in. of the roof, this space being left open for ventilation. The barracks for drafted men are similar in construction but with metal roofs and the 3-in. space omitted, the windows being depended upon for ventilation.

We see no reason why ⅞-in. boards with batten joints would not have a heat loss practically equal to the loss for frame construction (Data Sheet No. 1-E) consisting of studs and clapboards on one side. Ventilation to the extent of three or four changes per hour at least must be figured to keep up a sufficient air renewal to make these buildings reasonably healthy.

In regard to asbestos shingles and rubberoid roofing we are inquiring of the manufacturers if tests have ever been made for heat losses on such material. If authoritative data is procurable it will be incorporated in the Data Sheets.

Problems in Calculating Required Radiation.

EDITOR HEATING AND VENTILATING MAGAZINE:

Can you furnish me with answers to this list of questions over which I am puzzled?

How far below grade do you figure heat losses on outside walls and do you figure floor losses in heating basements?

In figuring the radiation for rooms used as cafés, etc., where a good many people pass in and out, is one air change per hour enough?

Is 1⅓ times the horsepower required to supply the radiation enough to give about the right margin of safety?

What per cent of steam is lost in passing through engines and what additional horsepower, if any, does it require?

I would like to have a rule for the size of the blowoff tank required.

Pittsburgh, Pa. H. F. S.

It is not our policy to advocate the figuring of heat losses below the grade line. This is because the earth on the outside of a basement wall where the building is kept constantly, or almost constantly, heated gradually approximates the wall temperature so that the major portion of the heat transmission soon ceases; this is even more true with the earth under basement floors. For this reason it has proven perfectly feasible to figure only the wall, glass, and ceiling surface above the grade line and *buildings so calculated* have given every *satisfaction* by maintaining the required inside temperature during extreme weather. In fact, owing to the greater protection from the wind, their temperature is less likely to be affected by gales than rooms entirely above ground.

While some engineers *do* figure dirt floors, and walls below grade, the only result is to increase the radiation required to a very small degree as the losses so figured do not amount to much. It is very necessary, however, to place in such rooms sufficient radiation to counterbalance all the heat losses above the grade and also one air change per hour if the room is unventilated. (See Standard Data Sheet No. 3 in the April, 1917, issue.)

As to the second question, we recommend doubling the radiation near any outside door but in cases where the doors are constantly opened and closed this, of course, would not be enough to meet such excessive conditions. In places such as store entrances, etc., it is usual to install vestibules with inner and outer doors, the radiation being figured for the heat loss of the vestibule plus three or four air changes per hour.

If the heat loss of the vestibule approximates the number of B.T.U. required for one air change then the heat loss would equal X and one air change will also equal X the normal computed radiator being equal to X + X or 2X. Doubling this gives a radiator of 2X × 2 = 4X of which X supplies the heat loss and 4X — X, or 3 X, is available for warming air. As one air change requires X radiation 3X will furnish heat for three air changes and tripling the radiation would give enough for 2X × 3 = 6X total; 6X — X = 5X, or five air changes per hour. In extreme cases it may be necessary to triple the nominal surface obtained by calculating on one air change as called for in the Standard Data Sheet.

Answering the third question, the boiler horsepower is quickly obtained from the *equivalent* direct radiation (E.D.R.) as follows:

$$\text{B.H.P.} = \frac{\text{EDR} + 25\% \text{ of EDR}}{100}$$

That is to say, one boiler horsepower (B.H.P.) will supply 100 sq. ft. of E.D.R. and the loss in the piping and the mains is assumed as 25%. The E.D.R. is total B.T.U. radiated divided by 250, the 250 being the B.T.U. equivalent efficiency of 1 sq. ft. of common direct radiation. By this formula for 10,000 sq. ft. of E.D.R. the total E.D.R., including piping, will be 10,000

Plus 10,000 × 25%.. 2,500

Total.............12,500 ÷ 100 = 125 H.P. for boiler.

The rating in horsepower for boilers is used almost exclusively for steel boilers and should be based on 10 sq. ft. of heating surface per nominal B.H.P. For the above example then the steel boiler heating surface should be 125 × 10 = 1,250 sq. ft.

This rating of 125 HP is practically 1⅓ times the direct radiator surface considering the fact that some direct surface is probably pipe coils but this ratio would not do where hot-blast heaters are in use owing to their much higher efficiency.

For the fourth question, steam in passing through an engine has a certain portion of its B.T.U. turned into energy and also loses another portion through condensation losses in the cylinder. This results in so small a change in the B.T.U. contained in the steam that it is seldom considered. In fact, there are many engineers who claim that exhaust from an engine will do more heating than an equal amount of high pressure steam. Thermally the exhaust will contain 90 to 95% of the heat contained in the high-pressure steam supplied to the engine, but under all ordinary conditions the heating requirements will be so far ahead of the engine requirements that the amount of heat absorbed in the engine may be safely neglected. Certainly no extra boiler horse-power is provided.

In reply to the last question, the size of the blowoff tank is to a great extent entirely arbitrary. Theoretically the blowoff tank should have a cubic capacity to allow the retention of all the water from the blowing down of one boiler. Actually a great many of the blowoff tanks would not do this if it is figured that a full gauge glass of water is blown down. A rational and practical size of tank can be obtained if assuming 3 in. of water level blown off by the following formula:

$C = 7.5 \text{ gal.} \times L \times W \times 4/12$

in which C is the tank contents in gallons, L is the length of the boiler in feet at the water line,

W is the width of the boiler in feet at the water line,

4 is the number of inches blown down increased by 25%,

12 is the number of inches in one foot.

This can be simplified to

$C = 2.5\ A$

if $A =$ the area of the water surface of the boiler.

The reason for adding 25% to 3 in., giving 4 in. approx. is that the blowoff tank is never fully used for water storage, about 25% of its depth being required as a vapor space above the water to allow the steam and vapor to separate freely from the blowoff water, thereby cooling it more rapidly.

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New Publications.

Finding and Stopping Waste in Modern Boiler Rooms is the title of a timely handbook prepared by engineers of the Harrison Safety Boiler Works, Philadelphia, Pa. The book is addressed to power plant owners, managers, engineers, and firemen. The preface states that such statements, tables, charts, etc., have been selected as were supported by experiments and tests, references being given wherever possible to the original authorities. The latter include many well-known engineers and writers in technical periodicals, also authors of papers before engineering societies, while the excellent bulletins on the utilization of fuel issued during recent years by the United States Bureau of Mines have been freely drawn upon. Pains have been taken to compare statements and to check each source of information against others.

The work is divided into five sections, the first of which is about "Fuels," under which are considered the coals of the United States and their classifications.

The second section is on "Combustion," taking up the chemistry of combustion.

The third section treats of "Heat Absorption," including heat transmission by conduction, convection and radiation, relation between heating surface and boiler capacity, boiler setting, refractories and fire-brick, soot, scale, softening feed water, and feed-water heating.

The fourth section on "Boiler Efficiency and Boiler Testing" covers heat balance, heat absorbed by boiler, heat losses due to moisture in the coal, efficiencies with different coals, boiler capacity and efficiency, and boiler trials.

The fifth section on "Boiler Plant Proportioning and Management" discusses various arrangements of auxiliaries with regard to their effect upon feed heating, and also describes the Polakov functional system of boiler room management.

The book has been compiled by George H. Gibson, A.S.M.E., assisted by Percy S. Lyon, now Captain of Coast Artillery. The proofs were read by Henry Kreisinger, who conducted for the United States Bureau of Mines many of the investigations quoted in the text.

The volume sells for $1.00 and may be obtained through the book department of The Heating and Ventlating Magazine.

Firing Bituminous Coals in Large House-Heating Boilers, by S. B. Flagg is a new publication (Technical Paper 180) received from the Bureau of Mines, Department of the Interior. The bureau has conducted a series of tests with some of the widely-used bituminous coals and this paper contains recommendations based on these tests. Fortunately the recommendations will also apply to those having charge of private buildings and apartment houses.

In view of the statement by Professor Breckenridge at the recent meeting of the heating engineers' society, that we would all have to adjust ourselves before long to the burning of bituminous coal, this new publication should have a special interest at this time. The recommendations on how to burn bituminous coals economically in these large house-heating boilers are as follows:

1. The fuel bed should not be seriously disturbed until the coal has become well coked, that is, until the gassy part of the coal has been largely driven off.
2. Both caking and non-caking types of coal may be used satisfactorily in boilers of this type, if properly handled.
3. The presence of a moderate proportion of screenings mixed with the lump coal causes the fresh charge of coal to heat more gradually and the emission of smoke is kept down more easily. Therefore such a proportion of screenings is an advantage.
4. Increasing the proportion of screenings in the coal necessitates the use of a stronger draft in order to carry the same load. Smaller firing charges must also be used and more frequent attention given. The tendency of caking coals to cake is increased and this also means that the first must have more frequent attention.
5. One large charge of coal fired by the spreading method will result in a longer

emission of dense smoke than the total emission of such smoke from two charges of half the size fired some time apart and by the alternate method.

6. With some coals, moderate charges fired by the alternate method necessitates less frequent attention to the heater than larger charges fired by the spreading method. Caking coals having a considerable proportion of fine coal or screenings are usually among these. Conversely, a fire will usually require more frequent attention when a lumpy caking coal free from screenings or a non-caking coal is fired in moderate charges by the alternate method.

7. The number of tests made was not large enough to justify conclusions regarding the relative efficiency with which a coal may be burned by the two methods of firing, but the author believes that in actual service over considerable periods better results will be obtained by the alternate method.

8. Frequency of cleaning the fires will be determined by the character of the coal and the rate at which it is burned, but with most coals the fires should be cleaned only once or twice in 24 hours in ordinary weather.

9. If the alternate method of firing is employed, the cleaning should be done before firing the fresh charge, and only one-half of the grate cleaned at a time. Then little or no smoke will result from the cleaning, because the side of the fire on which there is uncoked coal is not disturbed.

10. All three of the coals fired by the alternate method in the tests described were burned at rates corresponding to the heating conditions during the most of the winter, with scarcely any manipulation of the fuel bed except the cleaning of the fires and an occasional leveling just before firing.

11. The average fireman is apt to poke and slice the fire much more than is actually necessary. If a caking coal is used and the caked fuel must be broken up before it is well coked, slice the fire by running a straight bar under the fuel bed and raising it slightly so as to crack the caked mass. Do not stir the bed upside down by raising the bar through the fuel bed, nor break the bed with a bar from the top.

12. If the fuel bed is covered with a charge of fresh fuel in a layer more than 5 in. thick, the new charge, unless it is very free from slack, is apt to have a smothering effect. Then the output of the boiler will be correspondingly decreased and, especially if the spreading method of firing is employed, the mass of fresh coal will usually have to be broken once or twice before the fire will pick up. Consequently, the maximum firing charge should be not much thicker than 5 in. and for caking coals containing considerable slack it should not be more than 4 in. thick. Of course, when a fire is to be kept banked heavier charges may be used.

13. Do not fire large lumps of coal. Break all lumps into pieces no larger than fist size.

14. Large house-heating boilers do not require an intense draft to meet any reasonable demands for heat if the fuel bed is kept in proper condition, but the draft must be properly controlled.

15. The damper regulator should work freely with changes in steam pressure and should close the swinging draft opening in the ash-pit door before it starts to open the check draft in the smoke pipe.

16. The doors on the front of the boiler should fit snugly in their seats; special care should be taken to prevent any material wedging between the doors and the front and thus admitting air when or where it ought to be prevented from entering.

17. Do not allow clinkers to accumulate in the fire or too great a quantity of ashes on the grates. Be careful, however, in shaking the grates not to shake through unburned fuel.

18. In ordinary or severe weather keep an active fuel bed averaging 10 to 12 in. deep. In milder weather the depth of active fuel may be decreased by keeping a layer of ashes on the grate under the live coals.

19. Keep ashes removed from the ash pit.

20. Keep flue surfaces clean by brushing at least once a week.

Copies of this technical paper may be obtained free of charge by addressing the Director of the Bureau of Mines, Washington, D. C.

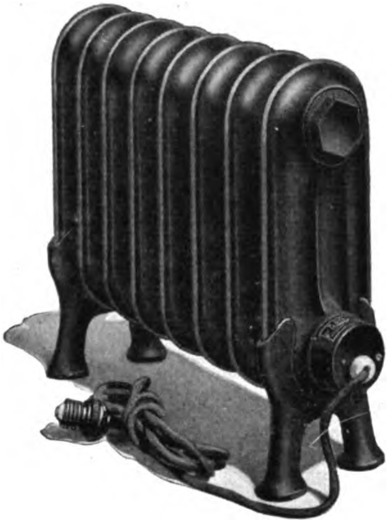
BULLETIN OF THE NATIONAL DISTRICT HEATING ASSOCIATION for January 15, 1918, contains, as its leading article "Coal Conservation: How We Can Promote It," by Davis S. Boyden, of Boston, in which he gives details of the steps taken in Massachusetts in this connection by the fuel administration. S. Morgan Bushnell writes, in a similar manner, on "Fuel Conservation in Chicago," this being supplemented by an interesting article on "Indoor Temperatures." Professor J. D. Hoffman contributes a paper on "A Problem in the Adjustment of Steam Heating Rates," in which he analyzes a specific case and reaches the conclusion that, in the case, which is fairly typical, a reasonable charge would be 60 cents per 1000 lbs. of steam delivered. This is based on an average coal cost of $4.50 per ton delivered. Seven pages are given over at the back of the *Bulletin* to a compilation, made by the American District Steam Company, of North Tonawanda, N. Y., of present and former steam heating rates in 36 cities.

ENGINE GUARDING AND ENGINE STOPS is the title of one of the latest publications of the National Safety Council, Chicago, Ill. After taking up construction suggestions for engine rooms, the pamphlet discusses guards on engines, some simple governor stops, independent safety-stops and their care, some home-made safety-stops, automatic vacuum-breakers, automatic circuit breakers, inspection of fly-wheels, governors, etc. The pamphlet concludes with notes on engine operation and a set of well-compiled engine-room rules. Pp. 16. Price 10 cents.

NEW DEVICES

A Portable Electric Nitrogen Radiator.

An unusual type of electric radiator has been brought out by the Willis Mfg. Co., Cleveland, O., and is known as the Willis electric nitrogen radiator. The radiator looks like the ordinary pressed steel radiator only smaller in size and is filled with nitrogen gas. It is stated that its heating capacity, size for size, is more than 100° hotter than a steam radiator and between 150° and 200° hotter than the usual hot-water radiator. It maintains an average temperature of 350° F. The radiator is made 14 in. high, 4¾ in. wide, with from four to ten sections. In its construction the electric heating element is surrounded by nitrogen gas. The gas fills the entire inside of the radiator which is hermetically sealed. Attention is called to the fact that nitrogen cannot burn or explode as it is an inert and non-oxidizing gas. While carried under a slight pressure, tests have shown that at no time will it reach more than one-quarter the tested pressure of the radiator.



WILLIS PORTABLE ELECTRIC NITROGEN RADIATOR.

Regarding cost of operation, for a 4-section radiator, containing 4 sq. ft., the consumption is estimated at 400 watts per hour, amounting to 2 cents, based on a rate of 5 cents per Kw. Hr.

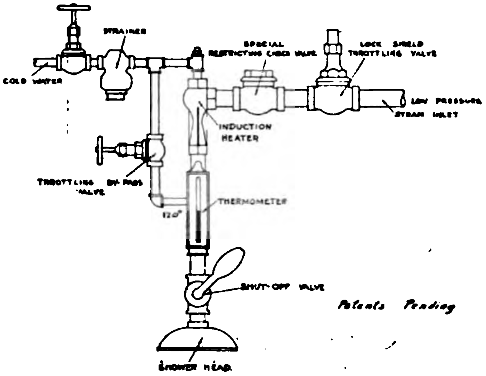
Willis radiators are designed for use on any electric current of proper voltage. The standard radiators are built for 110 volts, although the prices are the same for 220 volts. The prices range from $12.00 for a 4-section radiator to $25.00 for a 10-section unit.

Even Heat Shower and Hot Water Supply.

An arrangement for supplying hot water at any temperature desired up to 180° F. and maintaining an even temperature during use, has been designed by James A. Donnelly, New York, and is being placed on the market by the Donnelly Systems Co., New York. No tank or coil is required with this system, or thermostat for controlling the temperature. Exhaust steam is utilized from any source, or low-pressure live steam. The device is entirely automatic in its operation.

In starting the system the hot water

faucet is opened, draining the pipe from the induction heater. The temperature of the water is determined by the restricting effect of the special check valve and the setting of the lock-shield throttling valve. After this is done, if the pressure of water



DEVICE FOR SUPPLYING HOT WATER AT EVEN TEMPERATURE.

and steam used are substantially constant, there will be no appreciable variation in the temperature of the water delivered.

When used for a shower bath, an individual cold water pipe is run from the supply tank to each shower. The shut-off valve immediately above the shower head is opened and the maximum temperature of water (110°) will then be delivered. When the temperature is to be reduced, the throttling by-pass valve is used. The valve controls the temperature of the water issuing from the shower head, regardless of the operation of adjoining showers or other water fixtures.

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Trade Literature.

Recuperative Gas-Oven Furnaces, for accurate temperature work in hardening carbon steel, preheating and reheating high-speed steels, annealing, hardening, etc., are described and fully illustrated in a recent bulletin (No. 160) issued by Tate-Jones & Co., Inc., Pittsburgh, Pa.

Westinghouse Industrial Heating Apparatus, including electric air heaters for heating residences or other buildings, and electrically-heated ovens, such as enameling ovens, are the subject of a new catalogue (No. 8-E) sent out by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. The catalogue is supplemented with data on the electrical energy required for heating buildings, based on the formula:

$$\left(\frac{W}{4} + G + \frac{C}{55}\right)\frac{T}{3.4} = \text{heat losses in watts.}$$

This formula, it is stated, is to be used with judgment. The watts lost by radiation per square foot of surface per degree difference are given as follows:

Radiation Surface	Watts
24-in. brick wall	0.0575
12-in. brick wall	0.0925
8-in. brick wall	0.1350
4-in. brick wall	0.1930
Wooden flooring	0.0245
Wooden ceiling	0.0305
Fireproof flooring	0.0360
Fireproof ceiling	0.0425
Single window	0.355
Single skylight	0.300
Double window	0.170
Double skylight	0.185
Door (65% wood—35% glass)	0.170
Door-plain	0.120
Wood partition—1-in. thick	0.120

Pocket CO_2 Indicator, American type, described as the only practical CO_2 analyzer, always ready for use, compact and rugged, has been brought out by the Bacharach Industrial Instrument Co., Pittsburgh, Pa., and is described in a newly-issued circular. The circular contains a chart, reproduced herewith, showing that for coal-fired furnaces, about 40% of excess air is necessary to obtain the most efficient combustion. This is indicated by the highest CO_2 content obtained by this amount of air, as shown by the two curves. A greater percentage of excess air reduces the CO_2

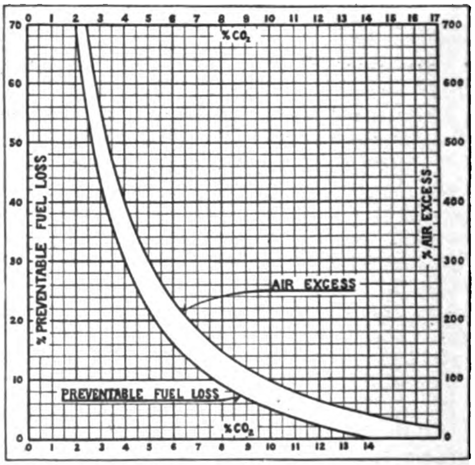
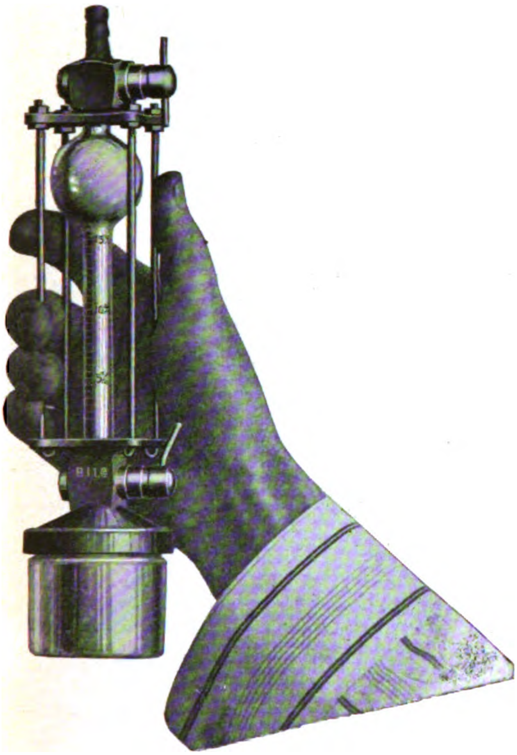


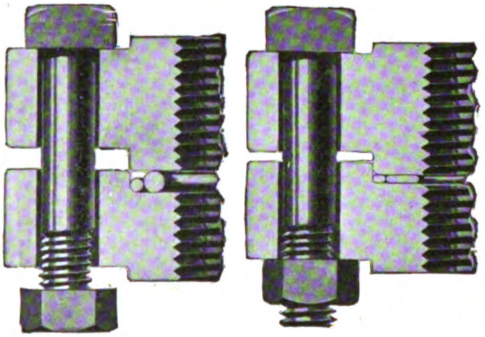
CHART SHOWING EXCESS AIR REQUIRED FOR MOST EFFICIENT COMBUSTION IN FURNACES.



POCKET CO_2 INDICATOR

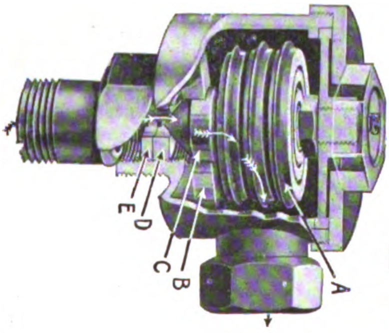
contents and therefore increases the fuel loss. Thus, for 300% excess air, the CO_2 drops to 5%, while the corresponding fuel loss becomes 21%. The new pocket CO_2 indicator is intended to replace the Orsat apparatus. It is stated that a test takes about 2½ min. and that one may go from one furnace to another and make tests with this device at the rate of twenty or more per hour. The circular contains full directions for use, accompanied by illustrations.

Sarco Merwath Metallic Gasket, is a new product brought out by the Sarco Co., Inc., New York, and presented in new circular matter. The gaskets are described as plastic and yet resilient. They do not become easily distorted so that they are not likely to be dstroyed when the joint is broken. The lead lying within the copper ring is retained in place and is designed to fill every unevenness in the surface of the joint. It is also pointed out that extreme pressure is not required to make the joint, and expansion strains are easily taken up without leakage. The gasket is made of hard copper and owing to the elasticity of this metal, it is stated that the gaskets do not deteriorate in service and that the joints made with them may be made and broken repeatedly. The gasket is made in four types, the non-corrosive type, a type for union connections where the coupling surfaces to be sealed are relatively narrow, a type with centering ring for flange connections and a copper type for superheated steam. These types are all illustrated in colors and their uses explained.

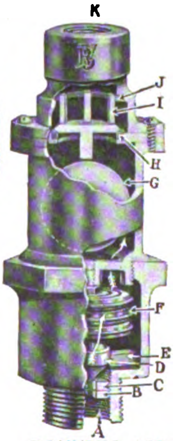


SECTIONAL VIEW OF SARCO GASKET BEFORE AND AFTER JOINT IS TIGHTENED.

Vapor Vacuum Heating, featuring the latest type of the Bottum thermostatic radiator trap, is discussed in a new catalogue published by the Bottum Valve Co., Chicago, Ill. Two new features have recently been added to this trap, one which makes it adjustable and the other consisting of a guide to conduct the disc in a straight line to its seat. The bodies of



BOTTUM THERMOSTATIC RADIATOR TRAP.



BOTTUM AIR ELIMINATOR

the traps are made of red brass, and are given a nickel finish. The Expansion members are filled with a low-expanding chemical fluid while under a vacuum. This gives them a percentage of expansion under various temperature conditions. It is stated that they will allow a small or large volume of water to pass with equal facility. These traps are especially adapted to installations where a pump is used, as the expansion members are entirely filled with the chemical. The catalogue also gives special prominence to the Bottum air eliminator which is designed to allow the air from a vapor heating system to escape but not the vapor or water. This device is built on original lines, its construction being illustrated and described in detail. Size 5x8 in. Pp. 16.

You Can Save Coal is the title of a circular devoted to the Syracuse packless valve, manufactured by the Syracuse Faucet & Valve Co., whose headquarters are now located at 101 Park Ave., New York, with E. F. Glore in charge. The circular explains how the construction of the Syracuse valve eliminates the danger of leaks at this point, the stem steam seat preventing any steam or water getting out of the valve, so that the valve never has to be packed.

Heating Ducts for Factory Buildings, as well as for schools, theatres, hotels, churches, etc., made of Pyrobar tile and Structolite, are the subject of a new circular issued by the United States Gypsum Co., Chicago, Ill. The illustrations show the use of this material for constructing the ventilating ducts for the Saxon Motor Company's new factory in Detroit. Pyrobar is a smooth-side partition tile and is made in all sizes, with faces 12 in. x 30 in., while gypsum which is used in this tiling, is well-known as an insular. Structolite, from which this tiling is moulded, is a specially-prepared gypsum product and is for use for wide ducts, difficult bends, etc., as it can be poured in place and reinforced as required.

Condensation Utilities, containing 22 prints of types of systems which the Farnsworth line of apparatus is capable of handling, is the title of a newly-published catalogue received from the Farnsworth Co., Conshohocken, Pa. Twelve types of machines are shown for handling condensation under almost any known condition, feeding it directly into the boiler under a closed or open system. The manufacturers state that with their large variety of improved machines they are collecting condensation and feeding it into boilers, in numerous instances, at 300° F., where previously the condensation had been allowed to flow to the sewer. The importance of this may be realized when it is stated that about 3300 lbs. of water is pumped into the average boiler for every 100 H.P. Most of the sketches shown were made as a direct result of visits to plants where conditions were found that required attention. All of the systems and the several types of machines listed in the catalogue originated and were designed by F. C. Farnsworth. Size 10 x 4 in. Pp. 16+24 sheets. Bound in loose-leaf form.

FOURTEEN 600-H.P. FARNSWORTH MACHINES SHIPPED ON ONE ORDER.

Daylight Saving Bill Before Congress.

The severity of the present winter, in most sections of the country has given an impetus to the agitation in favor of the passage of the daylight saving bill, now pending in Congress. Twelve European countries, including England, France, Germany, Austria-Hungary and Italy have adopted this plan, as has also Australia. As is well-known, the plan proposed in the bill is to turn the hands of the clock ahead one hour.

Current Heating and Ventilating Literature

Under this heading is published each month an index to the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the article mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

GAS FIRING

Gas Firing Boilers. T. M. Hunter. 15500 w. Instn E E—Oct. 1917. Study of the subject. Price on application.

Gas-Firing Boilers. T. M. Hunter. 3000 w. Elec'n—Nov. 23, 1917. Serial, 1st part. Abstract of paper before Instn. of Elec. Engrs. Drying and cleaning gas, heat transfer, types of boilers, etc. 40c.

HEAT TRANSFER

Heat Transfer from Air to Pipes. Charles H. Herter, with discussion. Ills. 6000 w. A S R E, Jl—Nov., 1917. Investigations of heat transfer problems. 60c.

The Transfer of Heat Between a Flowing Gas and a Containing Flue. Lawford H. Fry. 32 pp. A S M E—Dec., 1917. Formula with description. 40c.

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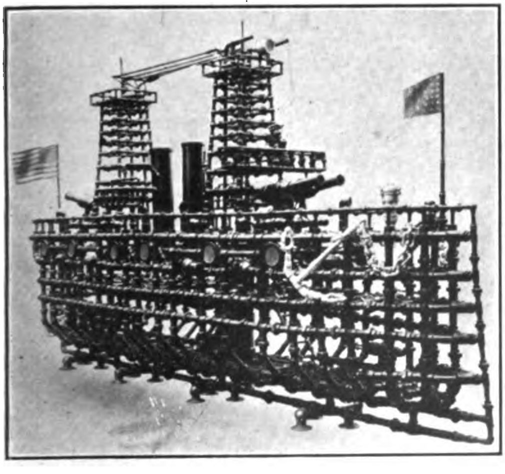
Model Battleship Made of Pipe Fittings.

A unique piece of pipe fitting, representing a model of the battleship New York, has been constructed in the Bridgeport shops of Crane Company by Julius Gerion, one of the company's mechanics. It is made entirely of articles manufactured by Crane Co. There are 6,669 separate pieces in the model, including 47 different types of pipe fittings, four different types of valves, brass whistle, oil cup and valve parts. In the hold are located the boiler and engines, with necessary steam piping. A 1/8-H.P. electric motor is included which operates a propeller shaft made from a gate valve spindle, while the propeller itself is made of galvanized pipe fittings. There is also a wireless installation, the aerial being made of 1/8-in. pipes suspended between the two masts.



MODEL BATTLESHIP MADE OF 6,669 SEPARATE PIECES OF PIPE AND FITTINGS.

The over-all length of the model is 186 in. and the total height from keel to top-mast is 102 in. The net weight is 3,308 lbs.

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Deaths.

CHARLES B. THOMPSON, president of the Thompson Heater Corporation, Buffalo, N. Y., and formerly manager of the Department of Research of the American Radiator Company, died at his home in Tonawanda, January 10. Mr. Thompson was ill but a few days, his death being caused by pneumonia. He was an old-time figure in the heating trade. After conducting a small heating, tinsmithing and plumbing business in Canada, he went to Boston in 1888 and became connected with the National Hot Water Heater Co. He was made manager of the firm's Chicago branch and when this firm was absorbed by the Ideal Boiler Company, he engaged in the heating contracting business in Chicago. About ten years later he joined the ranks of the American Radiator Company as manager of the company's research department in Buffalo. He formed the Thompson Heater Corporation about one year ago and was the designer of the Thompson heater placed on the market by this firm. He is survived by a widow and one son.

E. B. BADGER, founder of E. B. Badger & Sons Co., Boston, Mass., manufacturers of copper tanks, boilers and expansion joints, died at his home in that city, January 15. He was 89 years old. Mr. Badger was a native of Boston and had always lived there. When a young man he was apprenticed to a coppersmith and later became foreman of the establishment. He was afterwards taken into partnership. Some years later he formed the firm of E. B. Badger & Sons Company, which was originally a coppersmithing business. He held the office of president of the company until his retirement, about eight years ago. He is survived by seven sons, two of whom are officers of the company.

Standard Heating and Ventilating Data Sheets.

As the data sheets appearing from month to month in THE HEATING AND VENTILATING MAGAZINE increase in number, it is apparent that a listing of them in numerical order, rather than by the issues in which they appear, will simplify reference to previously-published sheets, as well as give some indication of those still to come. Some of the subjects, such as B.T.U. losses, and air changes, are complete. The series on chimneys, also, is now complete. The data sheets on ducts and flues and on radiators will include many sheets in addition to those published.

Attention has already been called to the fact that the sheets will not always appear in consecutive order. The reason for this will be understood by referring to the following table. For instance, on the subject of chimneys, this appears last on the completed list but as it formed a timely topic for presentation, it was run in ahead of other sheets. Similarly, in the matter of radiator data, in order to avoid the monotony of publishing a large number of sheets more or less similar, one or more will appear each month, accompanying data sheets on other subjects.

Extra copies of any of the data sheets, printed on one side only, may be had at 5 cents each, or $2.00 for a year's supply of 48 sheets.

No.	Date Issued		Subject
			B.T.U. Losses
1	Feb.,	1917	General.
1-A	"	"	Brick.
1-B	"	"	Stone and Concrete.
1-C	"	"	Combinations.
1-D	March,	"	Tile.
1-E	"	"	Frame Construction.
1-F	"	"	Glass, Skylight and Miscellaneous.
1-G	"	"	Ceiling, Floor and Roof.
			Exposure
2	April,	1917	General.
			Leakage
3	April,	1917	General.
			Temperature Range
4	April,	1917	Minimum Temperatures in U. S.
4-A	"	"	Minimum Temperatures in U. S. (continued).
			Computing Heat Losses
5	May,	1917	General.
5-A	"	"	Example.
			Ventilation
7	May,	1917	General.
			Air Changes
8	May,	1917	Churches and Theatres.
8-A	June,	"	Hospitals.
8-B	"	"	Hotels and Libraries.
8-C	"	"	Schools.
8-A	"	"	Miscellaneous.
			Properties of Air
9	July,	1917	Table.
			Ducts and Flues
10	July,	1917	General.
10-A	"	"	Elbows.
10-B	"	"	Anemometer Readings.
10-C	August.,	"	Underwriters' Rules.
10-D.	"	"	Underwriters' Rules (continued).
10-E	"	"	Underwriters' Rules (continued).
10-F	"	"	Velocities Recommended.
10-G	Sept.,	"	Vent Flue Velocities.
10-H	"	"	Areas of Pipes.
10-I	"	"	Areas of Pipes (continued).
10-J	"	"	Pipe Capacities at Various Velocities.
			Duct and Flue Details
11-A	Feb.,	1918	Flue Outlets and Dampers.
11-B	"	"	Details of Reversing Dampers.
			Radiation
13	Jan.,	1918	Radiation Computing.
13-A	"	"	Radiation Efficiencies.
13-C	"	"	Radiation Computing — Example.
			Radiators
14-A	Jan.	1918	Radiators — American 1-Col. Rococo.
14-B	Feb.,	"	Radiators — American 2-Col. Rococo.
14-C	"	"	Radiators — American 3-Col. Rococo.
			Chimneys
100	Oct.,	1917	General.
100-A	"	"	Residence.
100-B	"	"	Residence (continued).
100-C	"	"	Coal and Air per B.H.P.
100-D	Nov.,	"	Draft Loss in Fire and Boiler.
100-E	"		Draft, Theoretical and Effectual.
100-F	"	"	Draft, Theoretical, of Stacks.
100-G	"	"	Friction Losses in Steel Stacks.
100-H	Dec.,	"	Friction Losses in Brick Stacks.
100-I	"	"	Summary and Draft Reading.
100-J	"	"	Example of Computation.
100-K	"	"	Costs.

◆

Preventable Fire Causes in the United States.

In a bulletin published by the National Board of Fire Underwriters on "Safeguarding America Against Fire," the strictly preventable fire causes are given as totaling $60,466,054. Of this amount defective chimneys and flues came to $12,724,317; stoves, furnaces, boilers and their pipes to $11,204,875; gas, natural and artificial, $1,815,597. The partly preventable fire causes came to $99,606,293, consisting of those due to exposure, electricity, explosions, spontaneous combustion, incendiarism, lightning, sparks from machinery, sparks from combustion and miscellaneous. The unknown fire causes amounted to $48,632,993.

Weight of Round Galvanized Iron Pipe and Elbows

OF THE PROPER GAUGES FOR BLAST-PIPE SYSTEMS

Diameter of Pipe in Inches	Gauge of Iron	Weight per Running Foot in Pounds	Actual Weight of Full Elbow	Diameter of Pipe in Inches	Gauge of Iron	Weight per Running Foot in Pounds	Actual Weight of Full Elbow
3	25	0.9	0.6	38	18	23.7	179.8
4	25	1.3	1.1	39	18	24.3	189.4
5	25	1.6	1.6	40	18	24.9	199.2
6	25	1.9	2.3	41	16	31.5	258.4
7	25	2.1	3.0	42	16	32.2	270.7
8	25	2.4	3.9	43	16	32.9	283.3
9	25	2.7	4.9	44	16	33.7	296.2
10	25	3.0	6.0	45	16	34.5	310.3
11	24	3.7	8.2	46	16	35.2	323.8
12	24	4.1	9.8	47	16	35.9	337.6
13	24	4.4	11.4	48	16	36.7	352.6
14	24	4.7	13.2	49	16	37.4	367.0
15	24	5.0	15.1	50	16	38.2	381.6
16	24	5.4	17.1	51	16	39.0	397.6
17	22	6.9	23.5	52	16	39.7	412.8
18	22	7.3	26.3	53	16	40.5	430.5
19	22	7.7	29.3	54	16	41.4	447.5
20	22	8.2	32.8	55	16	42.3	464.8
21	22	8.5	35.9	56	16	43.0	481.3
22	22	8.9	39.3	57	16	43.8	499.2
23	20	11.0	50.7	58	16	44.5	516.2
24	20	11.5	55.1	59	16	45.3	533.6
25	20	12.0	59.9	60	16	46.0	552.5
26	20	12.4	64.3	61	14	57.5	701.5
27	20	12.9	69.9	62	14	58.4	724.2
28	20	13.4	75.2	63	14	59.3	747.2
29	20	13.9	80.6	64	14	60.3	771.8
30	20	14.4	86.3	65	14	61.2	795.6
31	20	14.9	92.4	66	14	62.2	821.4
32	18	20.0	127.4	67	14	63.0	844.2
33	18	20.6	135.8	68	14	64.0	870.4
34	18	21.2	144.2	69	14	65.0	897.0
35	18	21.8	152.7	70	14	66.0	924.0
36	18	22.4	161.5	71	14	67.0	951.4
37	18	23.0	170.5	72	14	67.9	977.5

The weights as given include the weight of rivets and solder, and due allowance has been made for laps and trimmings. The elbows have the internal radius equal to the diamter of the pipe. Rectangular pipes are usually made of the same gauge as round pipes of equivalent area.

Note—Square pipes will weigh about 27 per cent more than round pipes whose diameter is the same as the side of the square pipe. (From B. F. Sturtevant Co.)

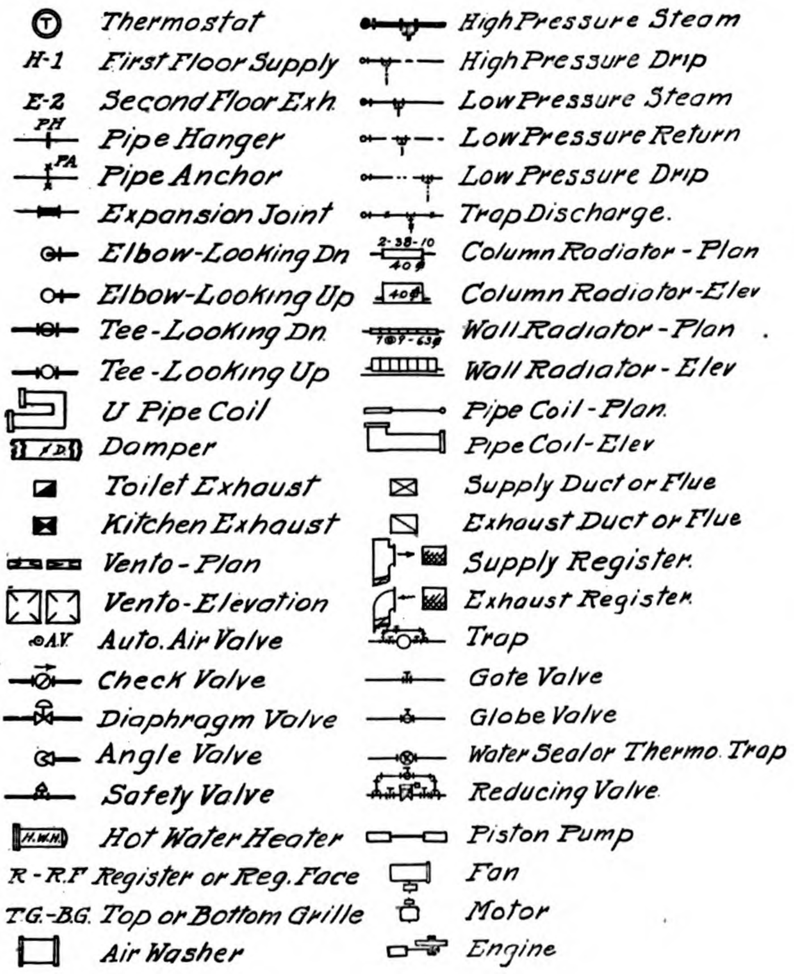
FOR REDUCING THE WEIGHT OF GALVANIZED IRON PIPE OF ONE GAUGE TO THAT OF ANOTHER GAUGE

Gauge.	GAUGE AND WEIGHT IN POUNDS PER SQUARE FOOT.																
	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
	4.53	3.91	3.28	2.97	2.66	2.41	2.16	1.90	1.66	1.53	1.41	1.28	1.16	1.03	0.91	0.84	0.78
12	1.00	0.86	0.72	0.66	0.59	0.53	0.48	0.42	0.37	0.34	0.31	0.28	0.26	0.23	0.20	0.19	0.17
13	1.16	1.00	0.84	0.76	0.68	0.62	0.55	0.49	0.43	0.39	0.36	0.33	0.30	0.26	0.23	0.22	0.20
14	1.38	1.19	1.00	0.91	0.81	0.74	0.66	0.58	0.51	0.47	0.43	0.39	0.35	0.32	0.28	0.26	0.24
15	1.53	1.32	1.10	1.00	0.90	0.81	0.73	0.64	0.56	0.52	0.48	0.43	0.39	0.35	0.31	0.28	0.27
16	1.70	1.47	1.23	1.11	1.00	0.91	0.81	0.71	0.62	0.58	0.53	0.48	0.44	0.39	0.34	0.32	0.29
17	1.88	1.62	1.36	1.23	1.10	1.00	0.90	0.79	0.69	0.63	0.59	0.53	0.48	0.43	0.38	0.35	0.32
18	2.10	1.81	1.52	1.38	1.23	1.12	1.00	0.88	0.77	0.71	0.65	0.59	0.54	0.48	0.42	0.39	0.36
19	2.38	2.06	1.73	1.56	1.40	1.27	1.14	1.00	0.87	0.81	0.74	0.67	0.61	0.54	0.48	0.44	0.41
20	2.72	2.36	1.98	1.79	1.60	1.45	1.30	1.16	1.00	0.92	0.85	0.77	0.70	0.62	0.55	0.51	0.47
21	2.96	2.56	2.14	1.94	1.74	1.57	1.41	1.24	1.09	1.00	0.92	0.84	0.76	0.67	0.59	0.55	0.51
22	3.21	2.77	2.32	2.10	1.89	1.71	1.53	1.35	1.18	1.08	1.00	0.91	0.82	0.73	0.65	0.60	0.55
23	3.54	3.07	2.56	2.32	2.08	1.88	1.69	1.49	1.30	1.20	1.10	1.00	0.91	0.81	0.71	0.66	0.61
24	3.90	3.37	2.82	2.56	2.29	2.08	1.86	1.61	1.43	1.32	1.22	1.10	1.00	0.89	0.78	0.72	0.67
25	4.40	3.79	3.18	2.88	2.58	2.34	2.10	1.86	1.61	1.49	1.37	1.24	1.12	1.00	0.88	0.82	0.76
26	4.98	4.30	3.60	3.26	2.92	2.65	2.37	2.10	1.82	1.68	1.55	1.41	1.27	1.13	1.00	0.92	0.86
27	5.40	4.66	3.90	3.54	3.07	2.87	2.57	2.28	1.96	1.82	1.68	1.52	1.38	1.23	1.08	1.00	0.93
28	5.81	5.01	4.20	3.80	3.41	3.09	2.77	2.45	2.13	1.96	1.81	1.64	1.49	1.32	1.17	1.08	1.00

The table above serves for the estimation of weights of pipe of gauges other than those given on Standard Data Sheet No. 169-E. Thus, suppose it is desired to find the weight of 28-in. pipe made of No. 16 gauge. From the 169-E table, pipe of this size made of No. 20 gauge weighs 13.4 lbs. per running foot. By the table above, the figure found at the junction of the column headed **16** and the line designated **20** is 1.60; therefore, the weight per foot of No. 16 gauge is 13.4 x 1.60 = 21.44 lbs.
(From B. F. Sturtevant Co.)

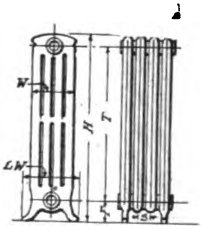
STANDARD HEATING AND VENTILATING SYMBOLS

While there are many symbols in use in various parts of the country and even by different designers in the same sections, the symbols shown below are the ones most closely approximated by a majority of the largest and most responsible firms engaged in such work. It is hardly necessary to point out the desirability of universally using the same symbols throughout the country and it is believed that the following are clear, practical and easy to make and read.



AMERICAN RADIATOR COMPANY'S ROCOCO FOUR-COLUMN RADIATORS FOR STEAM AND WATER

No. of Sections	* Length 3 in. per Sec.	Heating Surface — Square Feet					
		45-in. Height 10 sq. ft. per Sec.	38-in. Height 8 sq. ft. per Sec.	32-in. Height 6½ sq. ft. per Sec.	26-in. Height 5 sq. ft. per Sec.	22-in. Height 4 sq. ft. per Sec.	18-in. Height 3 sq. ft. per Sec.
2	6	20	16	13	10	8	6
3	9	30	24	19½	15	12	9
4	12	40	32	26	20	16	12
5	15	50	40	32½	25	20	15
6	18	60	48	39	30	24	18
7	21	70	56	45½	35	28	21
8	24	80	64	52	40	32	24
9	27	90	72	58½	45	36	27
10	30	100	80	65	50	40	30
11	33	110	88	71½	55	44	33
12	36	120	96	78	60	48	36
13	39	130	104	84½	65	52	39
14	42	140	112	91	70	56	42
15	45	150	120	97½	75	60	45
16	48	160	128	104	80	64	48
17	51	170	136	110½	85	68	51
18	54	180	144	117	90	72	54
19	57	190	152	123½	95	76	57
20	60	200	160	130	100	80	60
21	63	210	168	136½	105	84	63
22	66	220	176	143	110	88	66
23	69	230	184	149½	115	92	69
24	72	240	192	156	120	96	72
25	75	250	200	162½	125	100	75
26	78	260	208	169	130	104	78
27	81	270	216	175½	135	108	81
28	84	280	224	182	140	112	84
29	87	290	232	188½	145	116	87
30	90	300	240	195	150	120	90
31	93	310	248	201½	155	124	93
32	96	320	256	208	160	128	96



Connections: Both WATER and STEAM—Extra-heavy right and left-threaded nipples at top and bottom.

* Add ½ in. to length for each bushing.

DIMENSIONS

H = Total overall height.
T = C. to C. of tappings on water radiators.
F = Floor to center of bottom tapping.
W = Width of radiator—10½ in.
LW = Width of radiator legs—11¼ in.
S = Width of radiator sections—*i.e.*, c. to c. of sections or 3 in.

Nominal Height of Radiator	45-in.	38-in.	32-in.	26-in.	22-in.	18-in.
H	46	38 5/16	32 7/16	26 11/16	22 11/32	18 5/16
T	38 25/32	31 3/32	25 13/64	19 15/32	15 7/32	11 3/16

Note: For legless radiators deduct 3 in. from H.
For high legs add 2 in. and for extra high legs add 4 in. to H and F.
High legs on these radiators are special.

TAPPING DATA

All radiators are tapped 2 in. and bushed as follows:

SYSTEM	Size of Radiator, Square Feet	Supply In. Diam.	F In.	Return In. Diam.	F In.
Steam, one-pipe	Up to 24 inc.	1	4	..	..
	Over 24 up to 60 inc.	1¼	4	..	..
	Over 60 up to 100 inc.	1½	4	..	..
Steam, two-pipe	Up to 48 inc.	1	4½	¾	4
	Over 48 up to 96 inc.	1¼	4½	1	4
	Over 96	1½	4½	1¼	4
Water	Up to 40 inc.	1	4	1	4
	Over 40 up to 72 inc.	1¼	4	1¼	4
	Over 72	1½	4	1½	4

Air valve tappings are ⅛ in.
Vapor tappings, top and bottom, opposite ends ¾ in. supply and ½ in. return.
All tappings with right-hand threads unless otherwise ordered.

THE HEATING AND VENTILATING MAGAZINE

Cooperstown, N. Y. April, 1918 1123 Broadway, New York

The Proposed New Jersey-New York Vehicular Tunnel

How the Problem of Ventilation Will Be Solved in the New Highway Under the Hudson River.

When the scheme was first proposed of building a vehicular tunnel between Jersey City and New York it was quickly realized that the advent of motor cars, with their noxious fumes, would make necessary some very radical changes from ordinary tunnel construction. The air in the tunnel would not only become vitiated, but it was easy to see that the exhaust gases from the motors would be positively dangerous to health.

No such conditions existed when the great London tunnels were built and for that reason no arrangements were made for ventilating London's tunnels by mechanical means. Even to-day, although they accommodate many motor vehicles, natural ventilation is depended upon to secure the necessary air renewal. Taking the Rotherhithe Tunnel, London, as an instance, the average traffic between 8 a. m. and 8 p. m. on one typical day included 165 motor

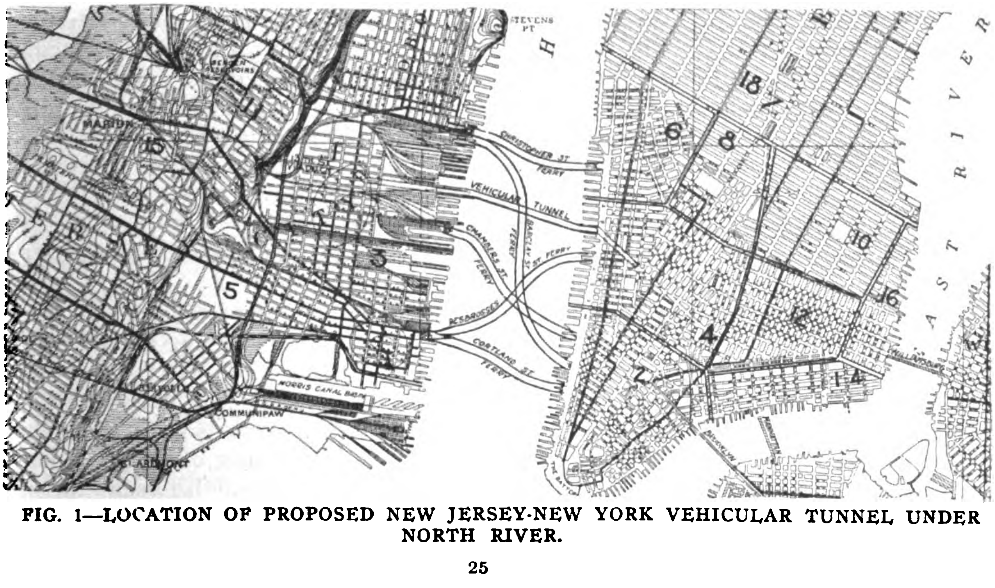


FIG. 1—LOCATION OF PROPOSED NEW JERSEY-NEW YORK VEHICULAR TUNNEL UNDER NORTH RIVER.

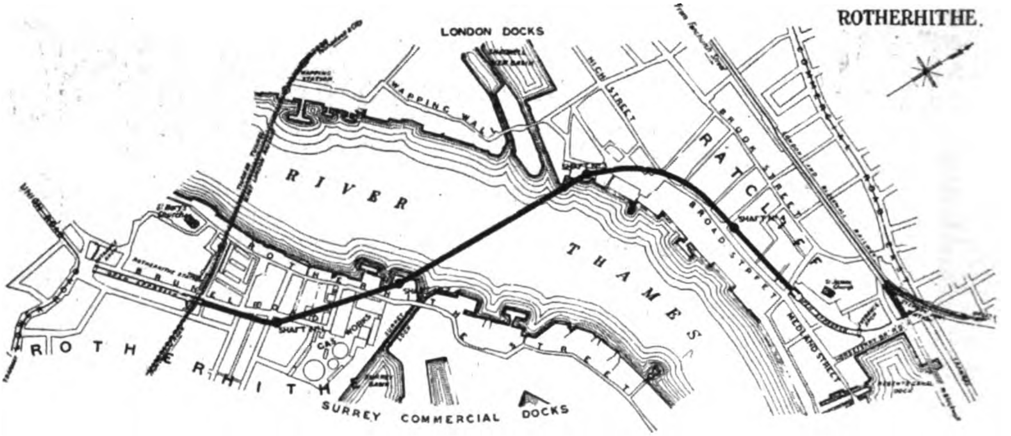


FIG. 2—ROTHERHITE VEHICULAR TUNNEL UNDER THE THAMES, LONDON.

vehicles and on another typical day, 186. Even with this comparatively small motor traffic it was found that the ventilation was distinctly bad and it was quite evident that, with the increase in motor vehicles, artificial ventilation will shortly have to be provided. On certain days the air in the tunnels is reasonably fresh, while on others, with equal traffic, it is very bad, depending upon the direction of the wind, and upon atmospheric conditions.

The land sections between the open ends and the first shafts are short and generally well ventilated, as fresh air enters the open ends and blows out at the first shaft. The inner sections, failing to get fresh air in any quantity from the entrances, depend upon the ventilating shafts to exhaust the bad air, which is then replaced by partially vitiated air from the outer sections. Ordinarily, the air in these sections, while unpleasant to breathe and trying to the eyes, is not so thick that it interferes in any way with traffic, but on days of great humidity the air in the inner sections is so heavy with smoke and vapor that it is impossible to see an approaching vehicle one hundred feet away. Tunnel employes work continuously in this atmosphere with no apparent ill effects.

The fact that there have been no serious prostrations, notwithstanding the passage of as many as 84 motor vehicles per hour through 1,200 ft. of practically unventilated tunnel, indicates that, with proper artificial ventilation, a much larger number of motor vehicles can pass in safety.

In the case of the proposed Hudson River tunnel it is estimated that the motor traffic per day will be not less than 4,249 motors in 1920, 6,870 in 1925 and 10,100 in 1930. It is also necessary to consider that on days when navigation on the river is impeded by fog, ice, or other adverse conditions, all of the motor vehicles in the district now served by the five downtown ferries would seek the tunnel and that, therefore, ventilation and other facilities should be provided for not less than 10,000 motors per day, with the possibility of increasing the facilities so as to provide against double that number.

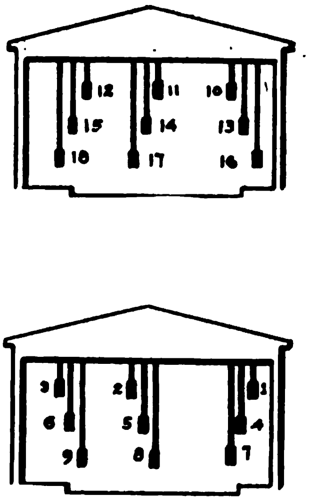
TEST IN EXPERIMENTAL TUNNEL SECTION.

One of the first steps taken, therefore, in the development of the project was to conduct a series of experiments to see whether it was feasible to take care of the fumes arising in the tunnel, especially on account of its great length of about 3,724 ft. between the two pierhead lines. These experiments were made under the auspices of the

Public Service Corporation of New Jersey on its property at Passaic Wharf, in Newark.

An air-tight building was constructed 125 ft. long, as a model of a section of the proposed tunnel, with roadways, sidewalks, etc., complete, including air ducts with openings into the top and bottom of the tunnel, and electrically-operated blowers and exhaust fans of proportionate size.

The tunnel section was filled with gasoline motor trucks and automobiles of various sizes, to the number of eight in all, and a series of tests was made under the direction of Dr. Gellert Alleman, of Swarthmore College. Samples of air taken at many points in the tunnel, with all the cars running, throttled down and racing, with and without ventilation, were analyzed. Tests were made with fresh air introduced at the top and exhausted at the bottom and similar tests with the direction of the air reversed. The volume and velocity of the air so introduced was measured, and a chemical analysis made of the air samples taken during these tests.



LOCATION OF PIPETTES IN EXPERIMENTAL TUNNEL SECTION.

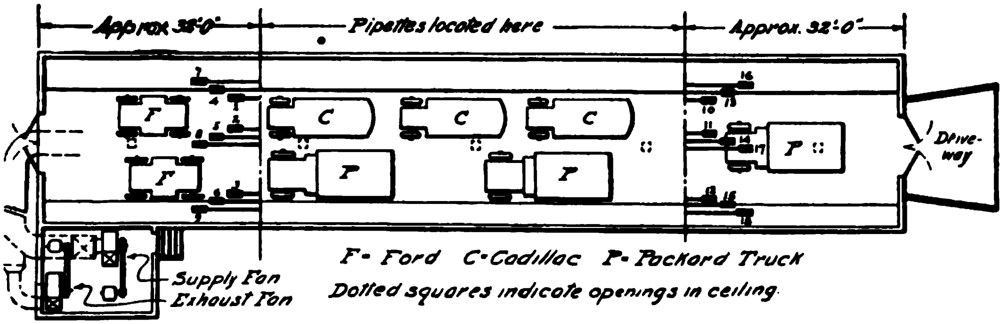


FIG. 3—ARRANGEMENT OF EXPERIMENTAL TUNNEL SECTION IN NEWARK, N. J.

The accompanying illustration, Fig. 3 shows the arrangement of the section as tested. The exact conditions of the tests and the results obtained were as follows:

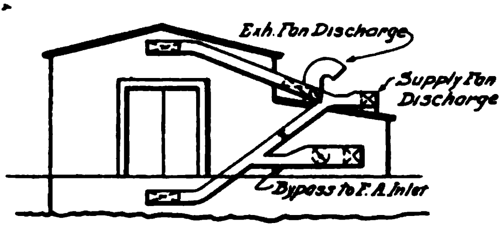


FIG. 4—LOCATION OF SUPPLY AND EXHAUST FANS IN EXPERIMENTAL TUNNEL SECTION.

CONCLUSIONS OF TESTS.

From the analytical results obtained Mr. Alleman draws the following conclusions:

1. When all doors and ventilators are closed and the engines of eight cars are racing for thirty minutes, the atmosphere becomes intolerable; the high content of unsaturated hydro carbons

Test No. 1—All doors and ventilators closed. Engines of eight cars (arranged as in illustration) all racing for 30 min. Average results:

	East End	West End	Tunnel Whole
	%	%	%
Unsaturated hydro carbons	0.15	0.34	0.25
Carbon dioxide	0.42	0.60	0.51
Oxygen	19.22	18.90	19.06
Carbon monoxide	0.59	0.57	0.68

Test No. 2—All doors and ventilators closed. Engines of eight cars all running light for 30 min.:

Unsaturated hydro carbons	0.03	0.01	0.02
Carbon dioxide	0.15	0.11	0.13
Oxygen	19.95	19.48	19.72
Carbon monoxide	0.39	0.47	0.43

Test No. 3—All doors closed and ventilators open. Engines of eight cars all racing for 30 min.:

Unsaturated hydro carbons	0.08	0.04	0.06
Carbon dioxide	0.11	0.12	0.12
Oxygen	20.44	20.28	20.36
Carbon monoxide	0.14	0.16	0.15

Test No. 4—All doors closed and ventilators open. Engines of eight cars all running light for 40 min.:

Unsaturated hydro carbons	*0.01	*0.01	*0.01
Carbon dioxide	0.07	0.04	0.06
Oxygen	20.51	20.57	20.54
Carbon monoxide	0.07	0.08	0.075

* Less.

Test No. 5—Same as Test No. 3, except that the direction of ventilation was reversed, the air entering the experimental tunnel at the top and leaving by the side ventilators on the floor.

Unsaturated hydro carbons	0.10	0.07	0.09
Carbon dioxide	0.16	0.07	0.12
Oxygen	20.50	20.45	20.48
Carbon monoxide	0.26	0.17	0.22

Test No. 6—Same as Test No. 4, except that the direction of ventilation was reversed, the air entering the experimental tunnel at the top and leaving by the side ventilators on the floor:

Unsaturated hydro carbons	0.07	0.03	0.05
Carbon dioxide	0.10	0.08	0.09
Oxygen	20.57	20.50	20.54
Carbon monoxide	0.21	0.18	0.20

("smoke") being responsible for a marked irritation of the eyes and respiratory organs, and the carbon monoxide producing distressing physiological disturbances. Such an atmosphere must be regarded as dangerous to persons who breathe it for a continuous period of fifteen minutes.

2. When all doors and ventilators are closed and the engines of eight cars are "running light" for thirty minutes, there is a marked improvement in the condition of the atmosphere as indicated under Test 2, but the breathing of such an atmosphere for a continuous period of fifteen minutes must also be regarded as dangerous.

3. When all doors are closed and the ventilators are open and exhausting from the top of the tunnel, with the engines of eight cars racing for thirty minutes, there is a further improvement in the condition of the atmosphere over that indicated under Test 1 and Test 2. However, the carbon monoxide content of this atmosphere must be looked upon as probably dangerous either to those persons who are physiologically weak, or to those persons who are particularly susceptible to this gas and who breathe it for a continuous period of thirty minutes.

4. When all doors are closed and the ventilators are open and exhausting from the top of the tunnel, with the engines of eight cars "running light" for forty minutes, the condition of the atmosphere is almost normal and the carbon monoxide content is not dangerous.

This conclusion is further supported by the fact that the eighteen persons who remained in the tunnel during this test, for a continuous period of forty minutes, experienced no unpleasant sensations from breathing this air and no subsequent distress.

5. When all doors are closed and the ventilators are open and exhausting from the bottom of the tunnel, with the engines of eight cars all racing for thirty minutes, the condition of the atmosphere is much worse than in Test 3, where the same conditions prevailed, except that the exhaust was made from the top of the tunnel. Such an atmosphere is not only unpleasant, but must be regarded as dangerous if breathed continuously for a period of thirty minutes.

6. When all doors are closed and the ventilators are open and exhausting from the bottom of the tunnel, with the engines of eight cars all running light for thirty minutes, there is only a slight improvement in the condition of the atmosphere over that indicated in Test 5. Moreover, the condition of this atmosphere is much worse than the air in Test 4, when the same conditions prevailed, except that the exhaust was made from the top of the tunnel. Such an atmosphere is unpleasant and must be regarded as dangerous if breathed continuously for a period of 30 min.

7. It appears that the direction of the exhaust air is of considerable importance, the most satisfactory results being obtained when the air enters the tunnel at the bottom and is withdrawn at the top. This was to be expected because of the fact that the exhaust gases leave the motors at a high temperature and are consequently lighter than air, and rapidly diffuse upward. The lateral propulsion of these heated gases into the atmosphere produces a motion which mixes the exhaust gases with the air, thus accounting for the fairly uniform distribution of the products of combustion in the atmosphere of the various parts of the tunnel.

8. Some of the odors which are unpleasant are in no sense dangerous and are produced by the "cracking" of lubricating oil.

These tests prove that the general method of ventilation outlined for the tunnel is entirely feasible, and that the products of gasoline combustion and smoke can be overcome by the introduction of air in the quantities specified and exhausted as described, leaving the air practically normal. The model tun-

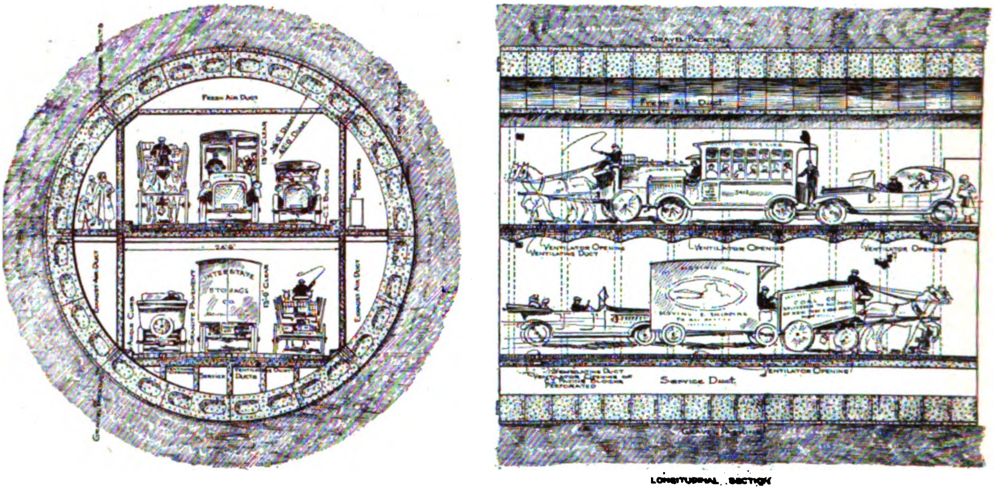


FIG. 5—TUNNEL DESIGNED BY JOHN F. O'ROURKE WHICH HAS BEEN ADOPTED BY THE JOINT BRIDGE AND TUNNEL COMMISSIONS.

nel will be maintained in its present location.

TYPE OF TUNNEL ADOPTED.

Three different types of tunnels have been developed and have been submitted to the commissions representing the two States. The commissions, in turn, submitted the various designs to General George W. Goethals for examination and report.

The design shown in Fig. 5, submitted by John F. O'Rourke, of the O'Rourke Engineering Construction Co., New York, is the one that was recommended for adoption by General Goethals. The joint Bridge and Tunnel Commissions of the two States, at a joint meeting, adopted the report by unanimous vote. The estimated cost of $12,000,000 was also approved. At the present time the State authorities of New York and New Jersey are taking action with a view of authorizing a contract for the immediate commencement of this tunnel, which can be completed in two years.

The O'Rourke design, as will be noted, provides for a tunnel 42 ft. in diameter, to be constructed of concrete blocks, the materials for which can be obtained without difficulty now. Its principal feature, however, is that it is to have two roadways, each of sufficient capacity to accommodate three lines of traffic in each direction.

One of the compelling factors that induced the commissions to adopt the O'Rourke design is the improved method of shield construction that was proposed at the same time by Mr. O'Rourke. This method, it is estimated, will reduce the time of construction to one-fourth of what it would be under the present method, if that were practicable, which is doubtful. This saving is accomplished by having the excavation conducted simultaneously from four levels, while the shield and lining have an air-tight joint between them, thus greatly reducing both the air pressure and the quantity of compressed air required.

The front part of the proposed shield is divided into separate super-imposed air chambers, each chamber projecting beyond the one immediately above it, so that the compressed air may spill out into the ground and rise through the water at the diminishing pressure of the water through which it is ascending. As a result the different air chambers maintain pressures corresponding to that of the water in front of them.

The construction of the shield also

provides means for closing the joint between the tail of the shield and the tunnel lining so that the water cannot enter the tunnel or compressed air escape from it, which avoids the great defect in the present shields. Having the excavation conducted simultaneously on four levels, it reduces the time, as stated, to one-fourth of what it would be if the work were done on one face, as is the present practice. The necessary cover over the shield is also reduced to one-fourth.

VENTILATING SYSTEM TO BE MODIFIED.

The system of ventilation shown in the plan (Fig. 4), in which the exhaust air is drawn out from the two roadways through gratings in the pavement, is only tentative. There is no question that this system would be effective with sufficient capacity provided in the exhaust fans. Subsequent studies of the question, however, show that the method is uneconomical and it is likely that the system that will finally be adopted will force the air from the shafts at the bulkhead lines into the tunnel to the center, at which point effective means will be provided for exhausting the air through large ducts back to the shafts.

It is probable that toward the middle of the tunnel there would be additional intake and exhaust facilities.

Forty-five air changes per hour in the tunnel is the minimum quantity at present under consideration, which, it is estimated, would give an entirely satisfactory diffusion of CO and CO_2. In fact, such a quantity of air, the designers state, would give substantially open-air conditions, with an assumed traffic of three lines of motor trucks every 60 ft. moving 10 miles per hour, and using the worst proportion of gasoline and air for combustion.

It is recommended that ventilation shafts be constructed at the bukheads on each side of the river, where they would offer the least obstruction. The semi-circular arch approach tunnels would be ventilated through specially designed electric light posts, the bottom part of which would consist of cylinders of sufficient diameter to afford the necessary capacity for the intake and exhaust blowers, which would be situated in the arches above the roadways at proper intervals.

EXHAUST OUTLETS AT PAVEMENT LEVEL.

It is contemplated that the intake blowers would discharge the fresh air at the top of the roadways of the tunnel and into the semi-circular spaces where the blowers are situated. The exhaust blowers would be connected to a separate system of ducts under the pavements, each for a given length of roadway, discharging the foul air through the light posts sufficiently above the level of the streets to obviate any nuisance therefrom.

OTHER METHODS PROPOSED FOR CONSTRUCTING TUBE.

It is interesting to note the way the tunnel problem has been approached by other designers, especially with regard to the ventilating provisions. For instance, in a design submitted by the Public Service Corporation of New Jersey, shown in Figs. 6, 7 and 8, a tube was proposed of such a size that two vehicles of the largest dimensions could be placed so as to give them a clearance of 3 ft. 6 in. between them, and an open space of 1 ft. 10½ in. between the wall of the tunnel and the other vehicle on one side and 3 ft. 10½ in. between the other wall of the tunnel and the other vehicle, and a clear space of 12 in. above their tops. This was based on the assumption that the vehicle of the greatest dimensions to use the tunnel will be 8 ft. wide and 12 ft. high.

Fig. 6 shows a cross-section of this design. The dimensions, it will be seen, make a space available for traffic

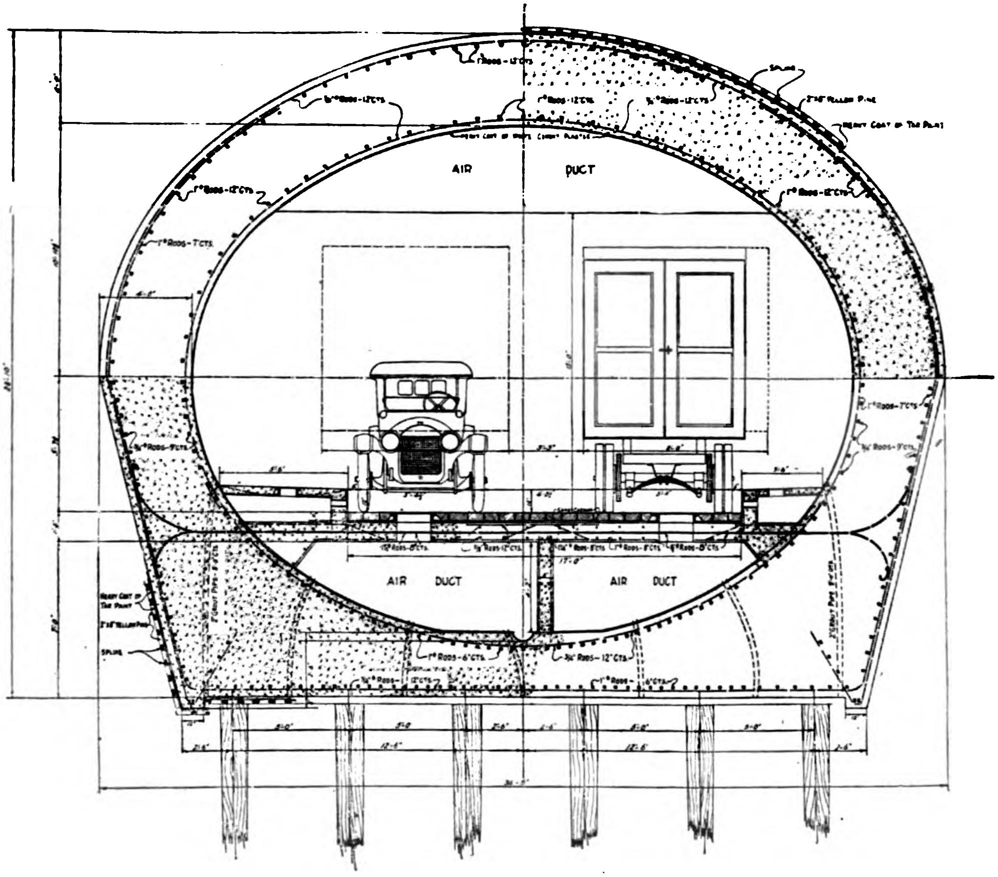


FIG. 6—TUNNEL DESIGN PROPOSED BY PUBLIC SERVICE CORPORATION OF NEW JERSEY.

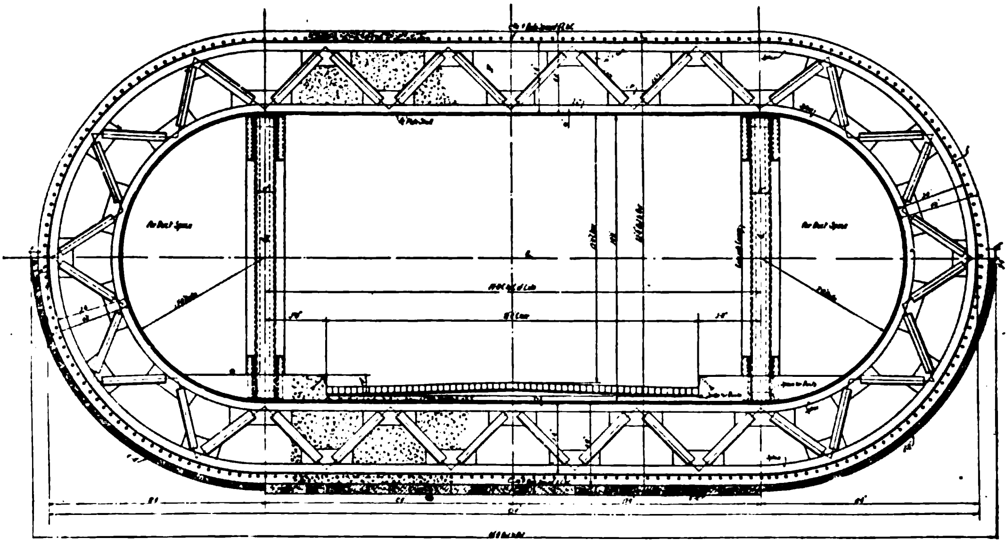


FIG. 7—CONSTRUCTION PROPOSED BY THE PUBLIC SERVICE CORPORATION FOR CLEARING THE BULKHEADS.

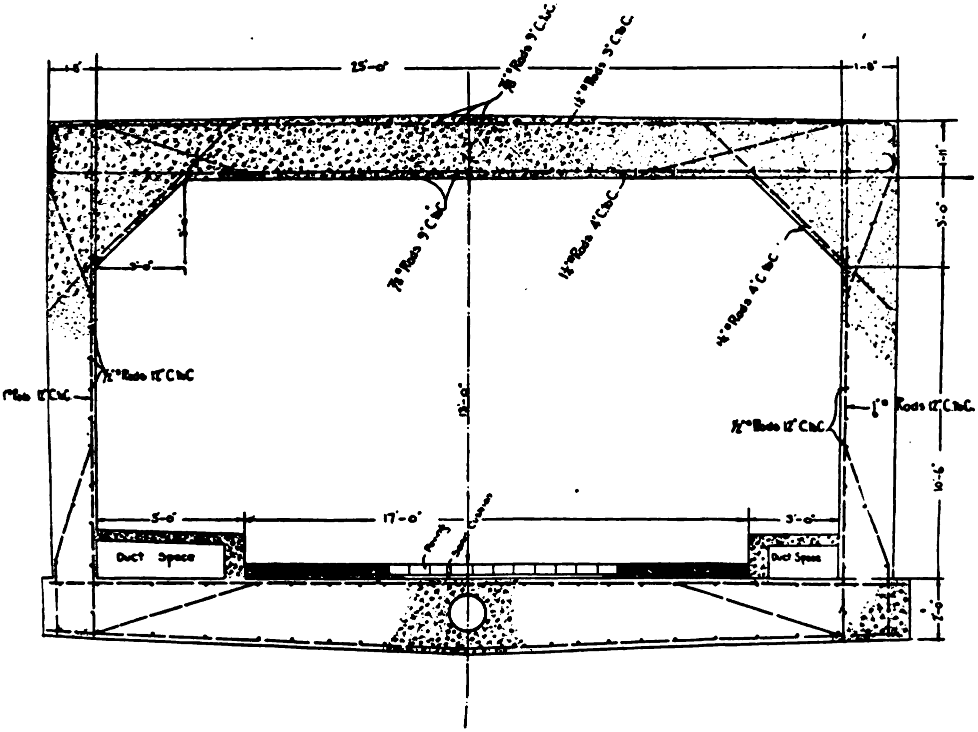


FIG. 8—REINFORCED CONCRETE APPROACH SECTIONS PROPOSED BY THE PUBLIC SERVICE CORPORATION.

in the tunnel 25 ft. wide by 13 ft. high, over all. Figs. 7 and 8 show the special construction proposed for clearing the bulkheads and the reenforced concrete approach sections, respectively.

This tube, it will be noted, was to be built in sections and sunk in the river. This plan was adjudged by General Goethals to be impracticable.

Another form of tunnel was recommended by Messrs. Jacobs and Davies, consisting of two cast-iron lined tunnels, each 33 ft. in diameter. This was not approved for the reason that the cost was prohibitive, apart from any other reasons.

◆

A BIT OF FINANCIAL HISTORY

The credit of the United States was so high and unquestionable that in 1900, two years after the Spanish War, 2 per cent bonds were offered at par and oversubscribed. This is a financial performance no other nation has ever equalled.

United States 4 per cent bonds in 1888 sold as high as 130 and in 1901 brought 139¼ on the stock market.

The United States has never defaulted on any of its bonds. Not one of its bondholders has ever lost a cent of principal or interest except those who voluntarily have taken losses by selling their bonds in a period of temporary price depression. One hundred cents on the dollar, principal and interest, has the United States always paid.

Back of the $250,000,000,000 to 300,000,000,000 of our national resources stands the rugged honesty of America. Liberty Loan Bonds are the safest security in the world.

CHICAGO COMMISSION ON VENTILATION

Test of Air Conditions in the Wholesale Tailoring Establishment of the John Gorman Company.

EDITED BY JOHN HOWATT

In order to ascertain the air conditions which exist in large work-rooms in buildings having several stories, with windows on less than all four exposures, and for comparison with other work-rooms having different conditions, a test was made in the plant of the John C. Gorman Company, wholesale merchant tailors, in March, 1917.

The work-shop of this company occupies the entire fourth floor of the McNulty Building at 1036 West Van Buren Street, Chicago, Ill. The building is of substantial brick construction and is built on the east and west lot lines, so it has windows only on the north and south sides. The building is approximately 100 ft. wide and 80 ft. deep, and the work room occupies the entire floor area on the fourth floor, with the exception of the space reserved for elevator and stair shafts, the floor being free of all except low partitions.

The different processes of manufacturing men's clothing are conducted on the floor tested. This results in movement of cloth and consequential high dust count in the air.

GAS ARC LAMPS AND STEAM MACHINES ADD TO AIR CONTAMINATION.

The ceiling height is less than 11 ft., and the width of the room is 80 ft. It is, therefore, necessary to use artificial lighting at all times. This is accomplished by means of twenty-three gas arc lamps and numerous incandescent electric lamps. It would be expected, therefore, that the CO_2 percentage in the air and the humidity would be high, due to the gas burned in the arc lamps. In addition to the gas arcs, two steam pressing-machines and fifteen gas-irons are used in pressing clothes, which further increase the CO_2 and the humidity.

NATURAL VENTILATION FOR WORK-ROOMS.

The work-room floor is heated by means of direct steam radiation placed beneath the windows. On the days the tests were conducted, however, all radiator valves were closed, so that as far

MUTUAL TAILORING CO. WHOLESALE MERCHANT TAILORS
LUKONE TAILORING CO. WHOLESALE TAILORS
BAKER-BROWNING CUT, TRIM & MAKE
SAL-KLOS MANFG CO.

McNULTY BUILDING, CHICAGO, IN WHICH THE JOHN GORMAN COMPANY IS LOCATED.

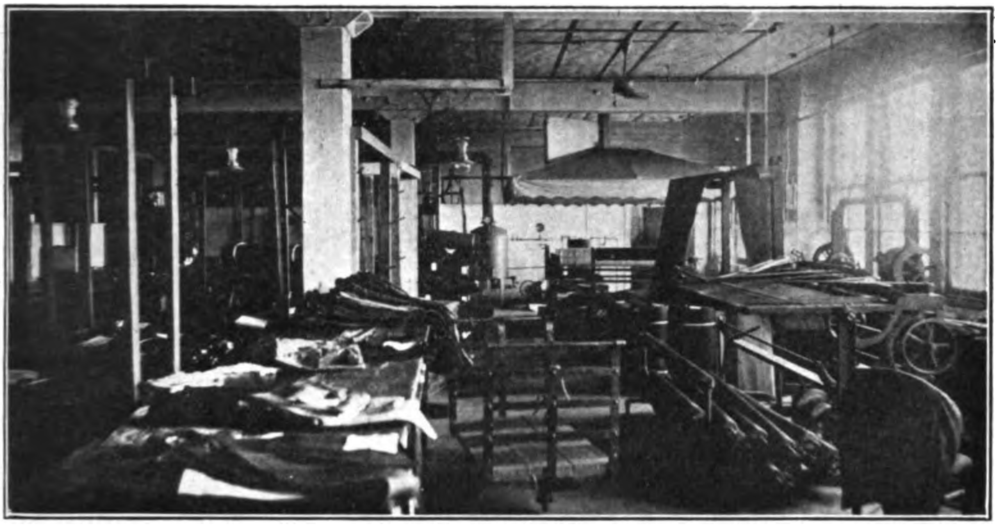


FIG. 2—GENERAL FLOOR ARRANGEMENT, TAILORING ESTABLISHMENT OF THE JOHN GORMAN COMPANY, NORTH END, LOOKING WEST.

as the test purposes are concerned they had no effect upon the result obtained. No mechanical ventilation is provided for the work-room, except the exhaust fan used in exhausting steam and fumes from the hood of the shrinking machine. The supply of fresh air for the entire floor is obtained through the windows.

TESTS CONDUCTED UNDER THREE DIFFERENT WIND CONDITIONS.

A view of the general floor arrangement is shown in Fig. 2. From the description given, it should be very evident that the air movement in the work-room will be dependent to a great extent upon the direction and velocity of the wind and upon the difference in temperature between the air outdoors and inside. A test was, therefore, conducted with the wind blowing, first, against the south windows;—second, parallel with the windows;—and third, against the north windows. The windows were maintained as nearly as possible the same throughout all tests. The air supply and exhaust, the CO_2, the dust particles and relative humidity were obtained by means of the usual instruments.

The quantity of air supplied in any room depending upon the window ventilation is very difficult to obtain by means of anemometers. An effort was made, therefore, to check the air supply by checking against the increase in CO_2. For this purpose the CO_2 in the outside air was considered as being 4 parts in 10,000, and a conversion factor of 0.91 was used in computing the cubic feet of CO_2 gas resulting from the burning of gas furnished at the time of the test by the Peoples Gas, Light & Coke Co.

RESULTS OF TEST NO. 1.

Data sheet No. 1 shows conditions found with the wind blowing from the southwest at a velocity of nine miles per hour. As indicated by the chart, the air movement across the room is quite noticeable. The prevalence of odors is recorded at stations toward the middle of the room and away from the windows on the windward side. This is to be expected. The CO_2 percentage does not build up toward the north side of the room, due to the fact that there is a complete air change through the windows every four minutes. The test shows an extraordinary high bacteria count at Station No. 20, and offensive odors were noted in this region. At this station eight men were engaged at the time of the test, steaming and pressing clothes with gas irons, accounting for the odor but not necessarily for the high bacteria count.

The results shown on the chart indicate considerable dust in the air. The dust count would be much higher were it not for the rapid air movement across the room toward the lee side of the building.

The effect of using gas in lighting and in pressing clothes is seen in the temperature and humidity readings. Although all radiators were shut off, with an outside temperature of 47° F., and a humidity of 80%, the inside temperature is 73.4° F., and the relative humidity is 56.8%. At this increased temperature, without increasing the humidity from using gas and from steam arising from the clothes pressing process the relative humidity would have been but 31%.

With the exception of Station No. 20, where the clothes pressers are engaged, the air conditions throughout the room under the weather conditions recorded in this test, are very good. Referring to the synthetic air chart (Fig. 3)* the total percentage of perfect in this instance was 76.49 with a dust count of 23,400, bacteria 11.6, odors 88%, CO_2 8.1, and distribution 88.4%. The wet bulb was 63° F. where it should have been 50° under these conditions.

RESULTS OF TEST NO. 2.

Data for Data Sheet No. 2 were obtained with the wind blowing parallel to the face of the windows. The records show clearly the stagnant condition of the air in the room, the air motion being negligible. As a consequence the dust count is very high, due to the lack of air currents to carry away the dust particles formed in the processes of manufacture. On the other hand, the bacteria count averages lower than in Chart No. 1, due principally to an unexplainable smaller bacterial count at Station No. 20. Again the effect of the gas on the temperature and humidity is noted. With all radiators shut off and an outside temperature of 40° F. and a relative humidity of 52%. the inside temperature is 73.2° and the relative humidity is 39.2%, whereas the relative humidity would be 17% were no moisture added to the air in the room. The percentage of perfect ventilation according to the synthetic air chart (Fig. 4) was 75.08.

RESULTS OF TEST NO. 3.

The data for Data Sheet No. 3 were obtained with the wind from the opposite direction to which it was when the data was obtained for Chart No. 1, that is, with the wind striking against the north windows. During this test the greater number of occupants were at the leeward side of the building;—thus, a high bacteria count and CO_2 test would be expected at stations Nos. 1, 2, 3, 4 and 5. The results, however, show no marked increase in CO_2 readings in any part of the room, due to the rapid movement of the air from the north to the south side of the building. The bacteria count is high at nearly every station. The dust count, except at the leeward side of the room is satisfactorily low.

The effect of the gas and pressing process on the room temperature and humidity is again demonstrated. With all radiators shut off and with an outside temperature of 47° F. and a relative humidity of 50%, the inside temperature is 63.4° F. and the relative humidity is 36.5%, whereas it would be 28% were no moisture added to the air in the room. The percentage of perfect ventilation according to the synthetic air chart (Fig. 5) was 81.17 giving the lowest dust count 14,200, the

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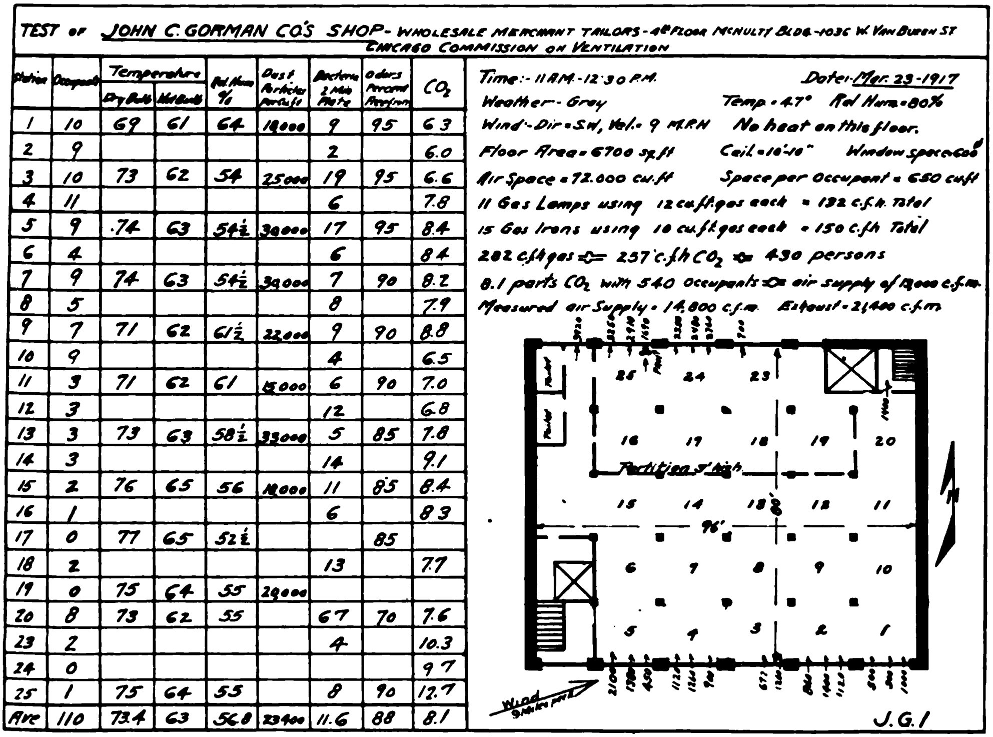
* For a description of the development of the Synthetic Air Chart see the JOURNAL of The American Society of Heating and Ventilating Engineers for July, 1917; also THE HEATING AND VENTILATING MAGAZINE for March, 1917.



TEST OF JOHN C. GORMAN CO'S SHOP - WHOLESALE MERCHANT TAILORS - 4th FLOOR McNULTY BLDG - 1036 W. VAN BUREN ST
CHICAGO COMMISSION ON VENTILATION

Station	Occupants	Temperature		Rel. Hum. %	Dust Particles per Cu. ft.	Bacteria 2 Min. Plate	Odors Percent Free from	CO_2
		Dry Bulb	Wet Bulb					
1	10	69	61	64	18000	9	95	6.3
2	9					2		6.0
3	10	73	62	54	25000	19	95	6.6
4	11					6		7.8
5	9	.74	63	54½	30000	17	95	8.4
6	4					6		8.4
7	9	74	63	54½	30000	7	90	8.2
8	5					8		7.9
9	7	71	62	61½	22000	9	90	8.8
10	9					4		6.5
11	3	71	62	61	15000	6	90	7.0
12	3					12		6.8
13	3	73	63	58½	33000	5	85	7.8
14	3					14		9.1
15	2	76	65	56	18000	11	85	8.4
16	1					6		8.3
17	0	77	65	52½			85	
18	2					13		7.7
19	0	75	64	55	29000			
20	8	73	62	55		67	70	7.6
23	2					4		10.3
24	0							9.7
25	1	75	64	55		8	90	12.7
Ave	110	73.4	63	56.8	23400	11.6	88	8.1

Time:- 11 A.M. - 12:30 P.M. Date - Mar. 23 - 1917

Weather - Gray Temp. = 47° Rel Hum. = 80%

Wind - Dir. = S.W., Vel. = 9 M.P.H. No heat on this floor.

Floor Area = 6700 sq. ft. Ceil. = 10'-10" Window space = 600

Air Space = 72.000 cu. ft. Space per Occupant = 650 cu. ft.

11 Gas Lamps using 12 cu. ft. gas each = 132 c.f.h. Total

15 Gas Irons using 10 cu. ft. gas each = 150 c.f.h. Total

282 c.f.h gas ⇔ 257 c.f.h CO_2 ⇔ 430 persons

8.1 parts CO_2 with 540 Occupants ⇔ air supply of 12000 c.f.m.

Measured air Supply = 14,800 c.f.m. Exhaust = 21,400 c.f.m.

DATA SHEET NO. 1, JOHN C. GORMAN COMPANY SHOP, SHOWING CONDITIONS WITH WIND FROM SOUTHWEST.

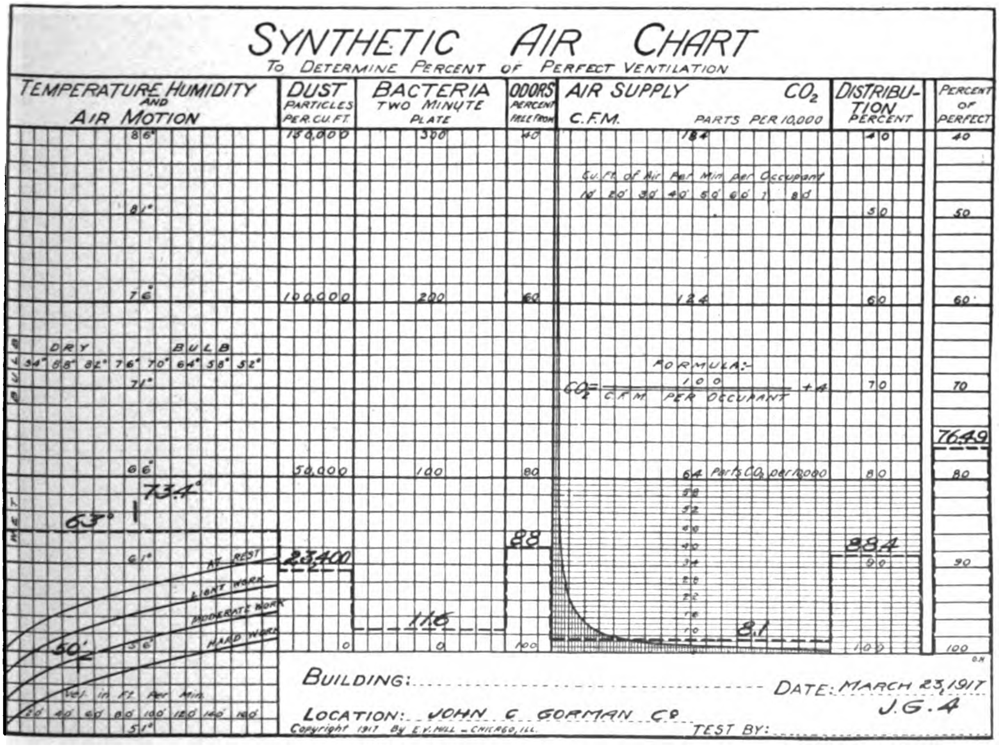


FIG. 3—SYNTHETIC AIR CHART FOR TEST NO. 1.

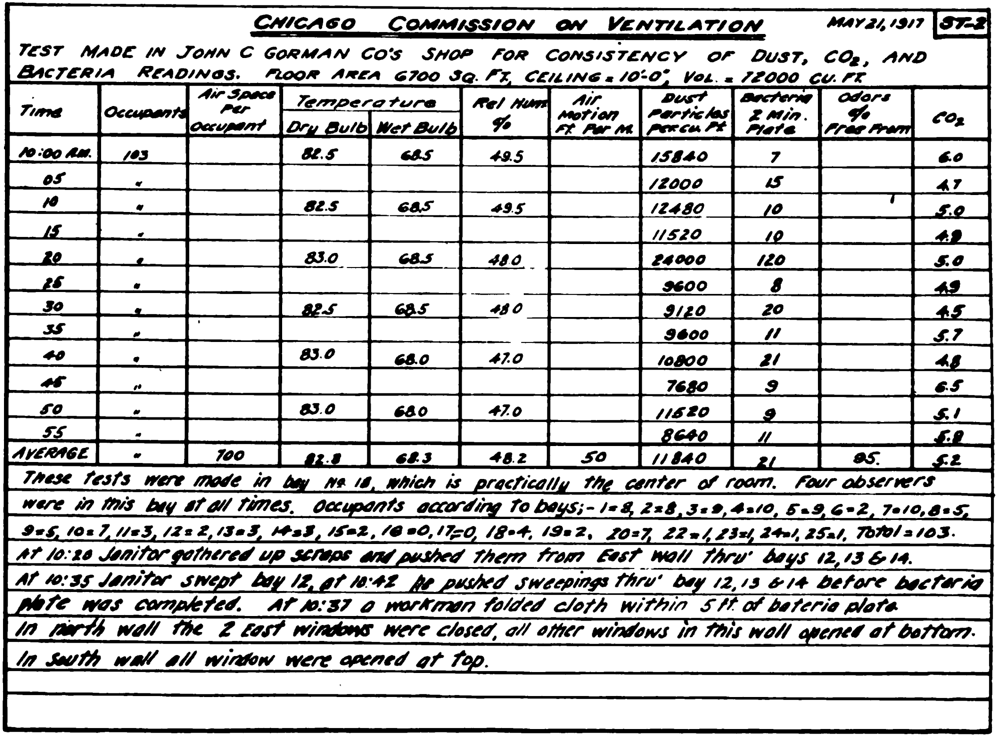
lowest percentage of odors 90%, and the lowest CO_2 content, 7.9 parts, with practically the same distribution as in test No. 1.

INDOOR CONDITIONS DEPENDENT ON WEATHER OUTSIDE.

The result of these tests demonstrates very clearly how dependent is the air condition inside a building of this type upon outside weather conditions. Constructed as it is with windows on the north and south walls, but with the east and west walls built solid and without any mechanical ventilation, when the wind is in a northerly or southerly direction good air movement is obtained across the entire room from the windward to the leeward side. When the outside temperature is below the freezing point, however, there is objection on the part of the workers in introducing untempered air through the windows, resulting in the windows being kept closed in cold weather and unsatisfactory air conditions in the room.

With an east or west wind striking against the solid brick walls, the air movement through the windows is negligible and the air within the room is very soon far from being in good condition.

The process of manufacture in this room is such that considerable quantities of heat and moisture are given off. This results in a badly overheated and over-humid condition whenever the outside temperature rises. In fact, when the outside temperature was 60° F. the air in the room was oppressively hot and moist. Removal of the gas arcs for lighting and substituting electric lighting for them would help to improve the air somewhat, but it will never be satisfactory under all conditions of outside weather until mechanical means are provided to supplement the present system of ventilation through the windows.



CHICAGO COMMISSION ON VENTILATION MAY 21, 1917 ST-2

TEST MADE IN JOHN C GORMAN CO'S SHOP FOR CONSISTENCY OF DUST, CO_2, AND BACTERIA READINGS. FLOOR AREA 6700 SQ. FT, CEILING = 10'-0", VOL. = 72000 CU. FT.

Time	Occupants	Air Space Per Occupant	Temperature		Rel Hum %	Air Motion Ft Per M.	Dust Particles Per Cu. Ft	Bacteria 2 Min. Plate	Odors % Free From	CO_2
			Dry Bulb	Wet Bulb						
10:00 A.M.	103		82.5	68.5	49.5		15840	7		6.0
05	"						12000	15		4.7
10	"		82.5	68.5	49.5		12480	10		5.0
15	"						11520	10		4.9
20	"		83.0	68.5	48.0		24000	120		5.0
25	"						9600	8		4.9
30	"		82.5	68.5	48.0		9120	20		4.5
35	"						9600	11		5.7
40	"		83.0	68.0	47.0		10800	21		4.8
45	"						7680	9		6.5
50	"		83.0	68.0	47.0		11520	9		5.1
55	"						8640	11		5.8
AVERAGE	"	700	82.8	68.3	48.2	50	11840	21	85.	5.2

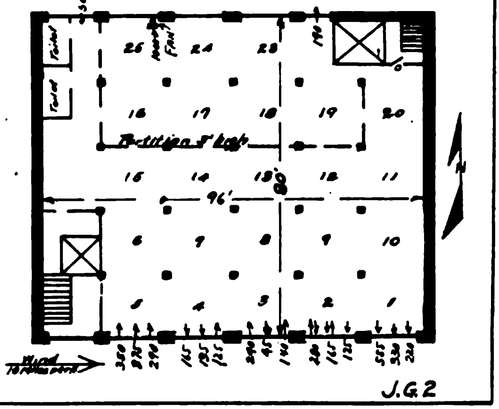
These tests were made in bay No 18, which is practically the center of room. Four observers
were in this bay at all times. Occupants according to bays;- 1=8, 2=8, 3=9, 4=10, 5=9, 6=2, 7=10, 8=5,
9=5, 10=7, 11=3, 12=2, 13=3, 14=3, 15=2, 16=0, 17=0, 18=4, 19=2, 20=7, 22=1, 23=1, 24=1, 25=1, Total=103.
At 10:20 Janitor gathered up scraps and pushed them from East wall thru' bays 12, 13 & 14.
At 10:35 Janitor swept bay 12, at 10:42 he pushed sweepings thru' bay 12, 13 & 14 before bacteria
plate was completed. At 10:37 a workman folded cloth within 5 ft. of bateria plate.
In north wall the 2 East windows were closed, all other windows in this wall opened at bottom.
In South wall all window were opened at top.

TEST FOR CONSISTENCY OF DUST, CO_2 AND BACTERIA READINGS.

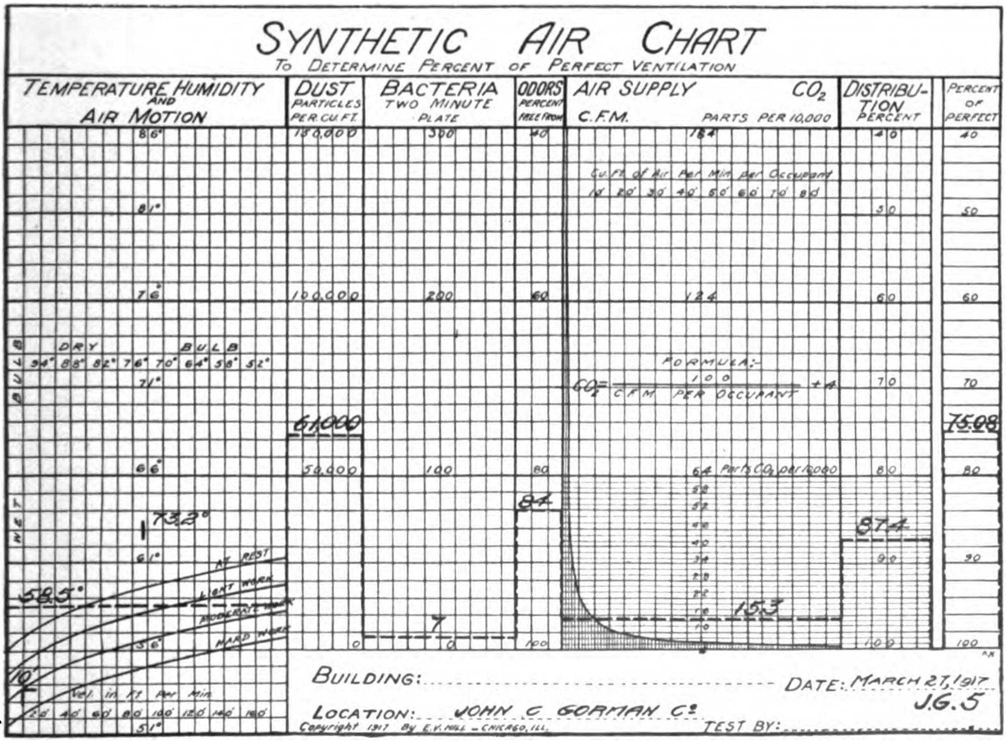
TEST OF JOHN C GORMAN CO'S SHOP- WHOLESALE MERCHANT TAILORS-4th FLOOR McNULTY BLDG-1036 W. VAN BUREN ST.
CHICAGO COMMISSION ON VENTILATION

Station	Occupants	Temperature		Rel. Hum. %	Dust Particles per cu. ft.	Bacteria 2 min. Plate	Odors Percent Free from	CO_2
		Dry Bulb	Wet Bulb					
1	10	72	56	37	35000	6	90	14.5
2	9					5	90	16.9
3	10	74	57	34	45000	11	90	14.0
4	11					12	90	12.2
5	9	75	58	35	72,000	12	90	13.9
6	4						80	12.6
7	9	74	58	38	60,000	8	80	14.3
8	5					7	85	13.8
9	7	73	58	40	60000	11	85	14.8
10	9					4	80	13.9
11	3	74	58	38	80,000		75	12.9
12	3					8	80	17.0
13	3	74	58	38	65,000		80	12.1
14	3					8	80	13.9
15	2	74	58	38	50,000	9	75	21.0
16	1					3	90	17.9
17	0	72	57	39			90	24.7
18	2					5	98	16.4
19	0	72	58	41			85	14.3
20	8	73	58	40		7	70	13.3
23	2	72	58	41		1	80	13.3
24	0					6	90	17.6
25	1	72	60	50		3	90	15.8
Ave.	110	73.2		39.2	61,000	7	84	15.3

Time: 10 A.M. 12:30 P.M. Date: Mar 27-1917
Weather:- Clear Temp. = 40° Rel. Hum. = 52%
Wind:- Dir. = W., Vel. = 10 M.P.H. No heat on this floor
Floor Area = 6700 sq. ft. Ceil. = 10'-10" Window Space = 600 #
Air Space = 72 000 cu. ft. Space per occupant = 650 cu. ft.
7 Gas Lamps using 12 cu. ft. gas each = 84 c.f.h. Total
15 Gas Irons using 10 cu. ft. gas each = 150 c.f.h. Total
234 c.f.h. gas ⇔ 213 c.f. CO_2 ⇔ 355 persons
15.3 parts CO_2 with 465 occupants ⇔ air supply of 4115 c.f.m.
Measured air Supply = 2320 c.f.m. Exhaust = 3830 c.f.m.



DATA SHEET NO. 2, JOHN C. GORMAN COMPANY SHOP, SHOWING CONDITIONS WITH WIND BLOWING PARALLEL TO FACE OF WINDOWS.



BUILDING: ....
DATE: MARCH 27, 1917
LOCATION: JOHN C GORMAN Co.
TEST BY: ....

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FIG. 4—SYNTHETIC AIR CHART FOR TEST NO. 2.

Discussion.

Data.

Occupants	110
Cubic contents	72,000 cu. ft.
Floor area	6,700 sq. ft.
Window area	600 sq. ft.

Ratio square feet window to cubic feet contents, 1 : 120

Ratio square feet window to floor area, 1 : 11.5.

Cubic feet of space per occupant, 650.

Floor space per occupant, 60.5 sq. ft.

The relation between the window area and the floor area (1 to 11.5, or 8.7%) is very low, being considerably below the minimum ratio of 1 to 8, or 12.5%; required by the State law for unventilated work shops. The insufficiency of window area is further evidenced by the necessity for artificial light at all times. It is particularly unfortunate that the north side of the building should be especially lacking in window area, the necessity for it being greater here than on the south or sunny side.

The ratio of window area to cubic contents is also very low (1 to 120). In this connection the idea presents itself that possibly the prevailing custom of basing window area on the floor space is less logical than would be the expression of the window area as a ratio of the cubic contents of the room, as by the method now in force. A very high room has no more provision for light and for the ingress and egress of air than a very low one, although obviously the amount of space to be illuminated and the amount of air to be moved to secure a complete air change, is greater. Further investigation of this question will be made in the endeavor to establish the proper relation of window area to cubic contents.

A striking example is presented in this building of the necessity of providing air for gas combustion, and for carrying off the products of combustion in addition to that required for ventilation. The large volume of fresh air entering from the windward side, when this side happens to be one on which there are windows, is barely sufficient to care for the needs of the occupants and the gas using appliances. When there is no wind pressure in through the windows, the deficiency of air supply is very marked and results in objectionable and dangerous conditions.

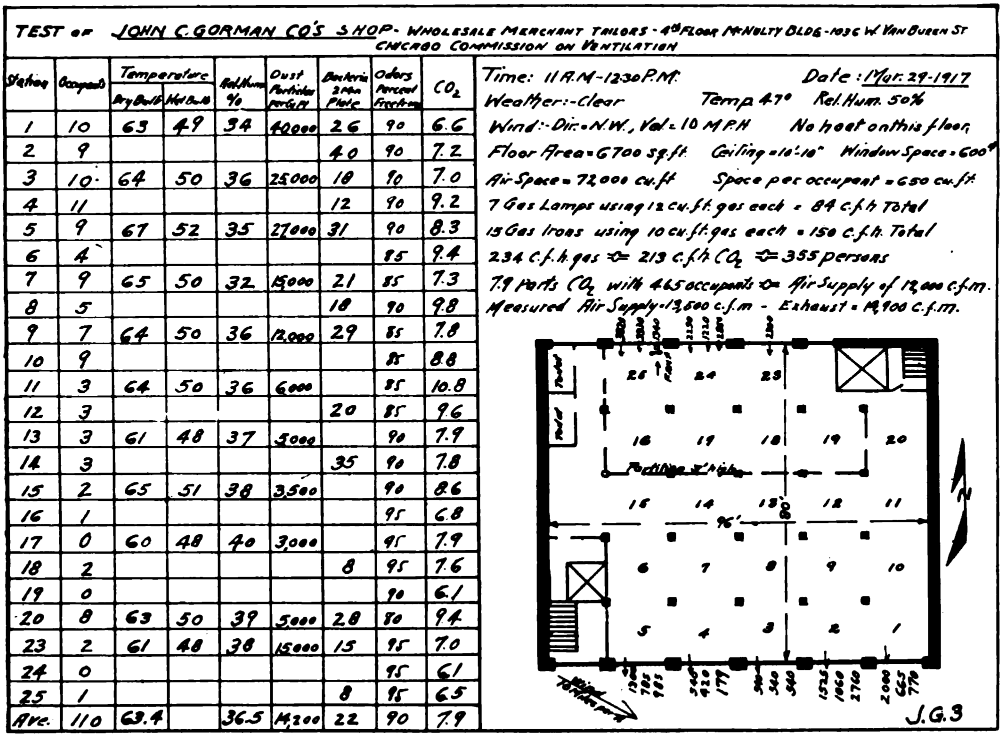
The volume of air delivered per occupant, under favorable and unfavorable wind conditions, was as shown in column A in the following table. The amount per occupant, however, when the equivalent air vitiating capacity of the gas burners is considered, is shown in column B.

	A. C.F.M	B. C.F.M.
March 23,	134	27.4
March 27,	21	5
March 29,	123	29

The character of the work done in this shop is such as to require large volumes of air to carry off the vapors arising from the steaming and pressing of clothes, to supply sufficient oxygen for breathing purposes, and for the combustion of gas in the lamps and irons. The air supply per person which was very low (5 C.F.M.) on March 27 when the outside temperature was 40° F. and there were seventeen windows open, would certainly approach the vanishing point in zero weather when the windows were closed tightly. It follows clearly that, in the drawing-up of requirements or in the design of apparatus for the ventilation of workshops of this character, consideration must be given to the oxygen-consuming effect of the lights and other gas-burning apparatus.

ROOMS VENTILATED BY WINDOWS SHOULD HAVE EXCESS HEATING SURFACE.

Provision should always be made in buildings having no mechanical ventilation, but which must depend on window ventilation, for heating surface in excess of that required to offset normal

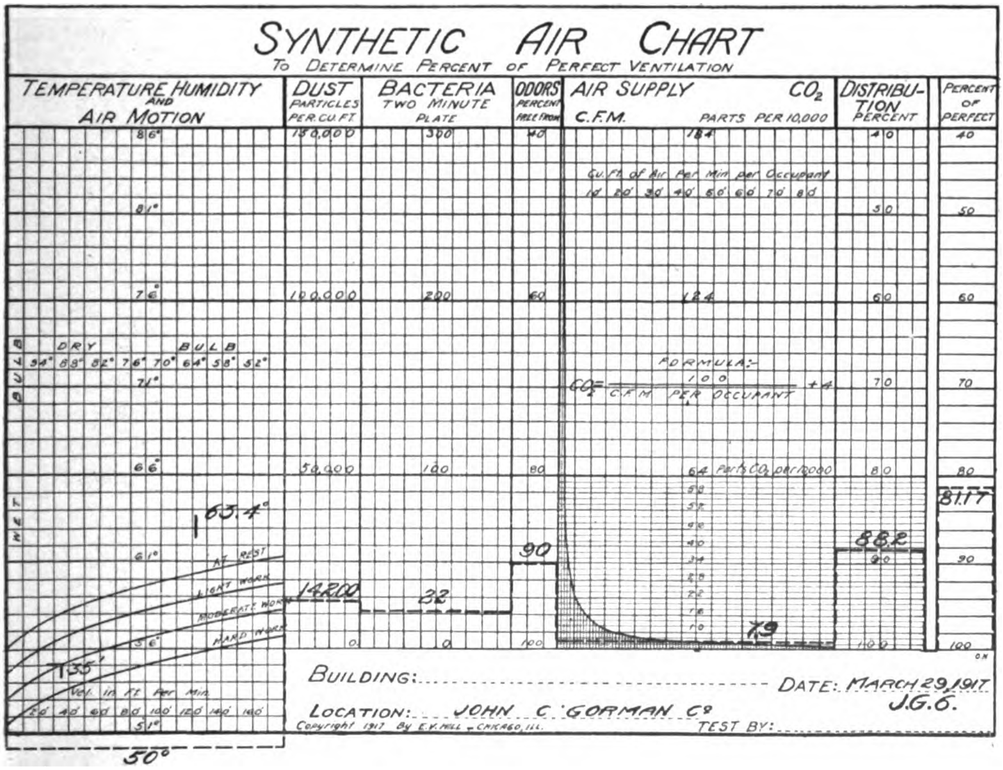


TEST OF JOHN C. GORMAN CO'S SHOP - WHOLESALE MERCHANT TAILORS - 4th FLOOR McNULTY BLDG - 1036 W. VAN BUREN ST
CHICAGO COMMISSION ON VENTILATION

Station	Occupants	Temperature		Rel. Hum. %	Dust Particles per Cu. Ft.	Bacteria 2 Min Plate	Odors Percent Free from	CO_2
		Dry Bulb	Wet Bulb					
1	10	63	49	34	40000	26	90	6.6
2	9					40	90	7.2
3	10	64	50	36	25000	18	90	7.0
4	11					12	90	9.2
5	9	67	52	35	27000	31	90	8.3
6	4						85	9.4
7	9	65	50	32	15000	21	85	7.3
8	5					18	90	9.8
9	7	64	50	36	12,000	29	85	7.8
10	9						85	8.8
11	3	64	50	36	6000		85	10.8
12	3					20	85	9.6
13	3	61	48	37	5000		90	7.9
14	3					35	90	7.8
15	2	65	51	38	3,500		90	8.6
16	1						95	6.8
17	0	60	48	40	3,000		95	7.9
18	2					8	95	7.6
19	0						90	6.1
20	8	63	50	39	5000	28	80	9.4
23	2	61	48	38	15000	15	95	7.0
24	0						95	6.1
25	1					8	95	6.5
Ave.	110	63.4		36.5	14,200	22	90	7.9

Time: 11 A.M.-12.30 P.M. Date: Mar. 29-1917
Weather:-Clear Temp. 47° Rel. Hum. 50%
Wind:-Dir.=N.W., Vel.=10 M.P.H. No heat on this floor.
Floor Area=6700 sq. ft. Ceiling=10'-10" Window Space=600□'
Air Space=72,000 cu. ft. Space per occupant=650 cu. ft.
7 Gas Lamps using 12 cu. ft. gas each = 84 c.f.h. Total
15 Gas Irons using 10 cu. ft. gas each = 150 c.f.h. Total
234 c.f.h. gas ⇔ 213 c.f.h. CO_2 ⇔ 355 persons
7.9 Parts CO_2 with 465 occupants ⇔ Air Supply of 12,000 c.f.m.
Measured Air Supply=13,500 c.f.m. - Exhaust=14,900 c.f.m.

DATA SHEET NO. 3, JOHN C. GORMAN COMPANY SHOP, SHOWING CONDITIONS WITH WIND FROM NORTHWEST.



BUILDING: ....
DATE: MARCH 29, 1917.
J.G.6.
LOCATION: JOHN C. GORMAN Co.
TEST BY: ....
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FIG. 5—SYNTHETIC AIR CHART FOR TEST NO. 3.

losses. This excess surface must be sufficient to warm the air admitted for ventilating purposes. Unless the radiation is placed adjacent to the air inlets and unless it has this excess capacity, there will be objectionable cold drafts, such as were observed in this building. The leakage factor normally provided in proportioning direct radiation is one air change per hour. Under the conditions in effect where windows are used for ventilation, this leakage factor must be increased by adding the maximum ventilation requirement. Failure to provide this excess radiation inevitably must result in the entire elimination of ventilation in cold weather.

Mechanical ventilation on the exhaust principle should be provided for the interior toilet. As arranged, when there is any ventilation of the main room, there is a tendency to withdraw toilet-room odors through the door. Such a contamination would be impossible if consistent exhaust ventilation of the toilet room were in effect.

Wardrobe Ventilation for School Buildings

Tests for Dust and Bacteria Conducted by Detroit Board of Health on Air Exhausted Through Cloakrooms.

By W. F. WALKER,
Sanitary Engineer, Detroit Board of Health.

In the summer of 1917 the Board of Health of Detroit, Mich., was requested to investigate the practice of exhausting air from school class rooms, through the wardrobes and to report to what extent the results of such practice were detrimental to the health of the children.

The problem, naturally resolved itself into two components: First a study of the extent to which dust is deposited or filtered out on the outer garments hung in the wardrobes and the possible danger of such dust, and second: The possible transmission of germs of communicable diseases through the medium of the outer garments. The investigation by the Board of Health was carried on at the Duane Doty School, being a typical example of that class of schools ventilated in this manner. Observations were not made at other schools as the general principles applied to all of those of this class.

EQUIPMENT FOR VENTILATING DUANE DOTY SCHOOL.

The Doty School is mechanically ventilated, air being drawn from above the roof through an air intake to the basement heated and discharged into the room at the rear about 8 ft. above the floor, at the rate of about 1,500 cu. ft. per minute. The air is forced well to the front of the room, and travels back through the breathing zone at low velocity and leaves the room through the wardrobes at the rear, the sliding doors of which are so arranged as to leave an 8 in. by 36 in. opening at the floor. About 60% of the air supplied finds its exit this way. The rest is lost by leakage through windows and doors.

METHODS OF MEASURING DUST IN AIR LEAVING ROOM.

To determine the amount of dust present in the air leaving the room samples were collected by means of the Palmer apparatus (described in *The American Journal of Public Health* for January 1916) 6 in. above the floor, at the opening into the wardrobe. To determine the amount of dust deposited, samples were taken with the same apparatus in the attic, the Palmer apparatus being placed in the flue opening leading from the wardrobe. The result of this examination showed that on an average 0.781 grams of dust were deposited per day somewhere between the opening into the wardrobe and the outlet of the flue. This method is faulty in that only the lighter dust would be carried up the flue by the ascending air column; heavier particles which might be present in the air near the floor would not show themselves in the analysis of the air at the outlet.

Because this method did not give us the true condition, a study of the air dustiness was made by a method devised by Dr. E. Vernon Hill and described by him in THE HEATING AND VENTILATING MAGAZINE for June, 1917. This method consists in microscopically counting the dust deposited on a cover slip from a known volume of air. The average of the observations made show the following results:

Number of dust particles per cubic foot in air entering room, 24,000; average number of dust particles per cubic foot in air in front of room in breathing zone, 26,200; average number of dust particles per cubic foot in center of room in breathing zone, 32,600; average number of dust particles per cubic foot in wardrobe, 16,400.

It is evident from these and other observations, that the amount of dust in the wardrobes is not so great by 50% as in the room, and that the children's garments hanging in the wardrobes are as safe from dangerous dust as they are when hanging in the average home and safer than when being worn upon the street.

DETERMINING DANGER OF TRANSMISSION OF COMMUNICABLE DISEASES.

To determine the danger of transmission of communicable diseases, bacteriological examinations of the air were made by exposing nutrient agar plates at various locations, for periods of 2 minutes, incubating 48 hours at 37° C. and counting colonies. The minimum count of those plates exposed in the room in the breathing zone was 5, the maximum 48, with an average of 15. The examination does not show any stratification.

The results of the analysis in the wardrobe show the minimum count to be 7, the maximum 48, with an average of 16.

It is noticeable in this instance, however, that plates taken above the clothing at a height of 5 ft. from the floor frequently show a count in excess of a plate simultaneously taken near the floor, there being some evidence that the clothing gives some dust and some bacteria to the air.

It is conclusively shown that the clothing does not act as a filter to any appreciable extent, and that the danger of contact infection from child to child or of droplet infection by coughing or sneezing greatly outweighs any possible danger of transmission by means of outer garments.

All of which facts lead to the conclusion that the practice of exhausting air from the school room through wardrobes cannot be considered in any way detrimental to the health of the children.

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A. S. ARMAGNAC, Editor
GUSTAVE PETERSEN, Business Manager
HAROLD L. ALT, Contributing Editor

European Representative:
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As these words are written the armies in Europe are engaged in the mightiest struggle in the history of the world. The issue of that struggle may long remain in doubt, but, in these critical days, there is no doubt in the minds of red-blooded Americans as to the final issue of the war. As one American officer put it, when asked how long the conflict would continue: "If you can tell me how long it will take to defeat Germany, I will tell you when the war will end." President Still of the heating engineers' society expressed it equally well when he said, "The only thing that matters is the winning of the war."

Our course, therefore, stretches out before us, straight and clear. Every American soldier in France and every American sailor on the seas must and will be backed to the limit. Just at this time, that backing resolves itself into the putting over of the Third Liberty Loan. In spite of the fact that the amount of the loan will be $3,000,000,000, instead of a higher figure, and that the interest rate will be 4¼%, make no mistake about it—every ounce of effort will be needed to make the loan a success. We cannot afford to fail—the matter is too vital. The army here and in the trenches will receive a wonderful inspiration when the news reaches them that the loan is not only an overwhelming success but that "there is more up the river than has ever come over the falls."

◆

WHAT your Liberty Bond will accomplish:

A $1,000 bond will buy six cases of operating instruments for a base hospital, or furnish pistols for a rifle company, or one motor kitchen.

One thousand five hundred dollars of Liberty Bonds will buy a motor ambulance, or a motor car for a machine-gun battalion.

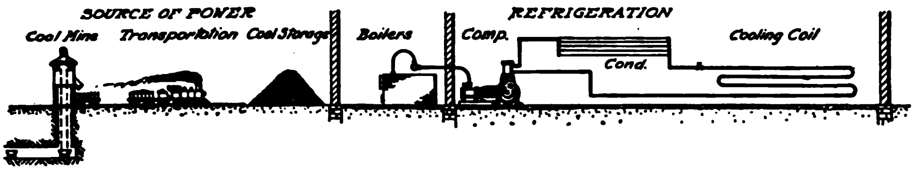
Two $1,000 bonds will buy a motor truck; three $1,000 bonds will buy rifles for a Field Artillery battery, or supply horses for a Field Signal battalion.

Four $1,000 bonds will buy a tractor; five $1,000 bonds will buy one Liberty truck, or seven Lewis machine guns, or equip a rifle company with rifles.

Six $1,000 bonds will buy a Liberty motor; seven $1,000 bonds one training plane; nine $1,000 bonds one observation balloon.

Ten thousand dollars of bonds will fully equip three hospital wards of 50 beds each, with all linen, clothing, and other necessaries, or buy six large wholesale sterilizing outfits, or six motor ambulances.

AIR COOLING AND REFRIGERATION



A Non-Gaseous Refrigeration Machine

Cooling as a result of the evaporization of water is well understood by ventilating engineers, its application being constantly used in air washer work. That such cooling can be extended under proper conditions to the point of refrigeration will, perhaps, come somewhat as a surprise to many; yet it can easily be seen that if a small cooling effect is obtainable under ordinary conditions it only remains to increase this cooling effect sufficiently under artificial conditions to produce the required drop in temperature necessary for refrigeration.

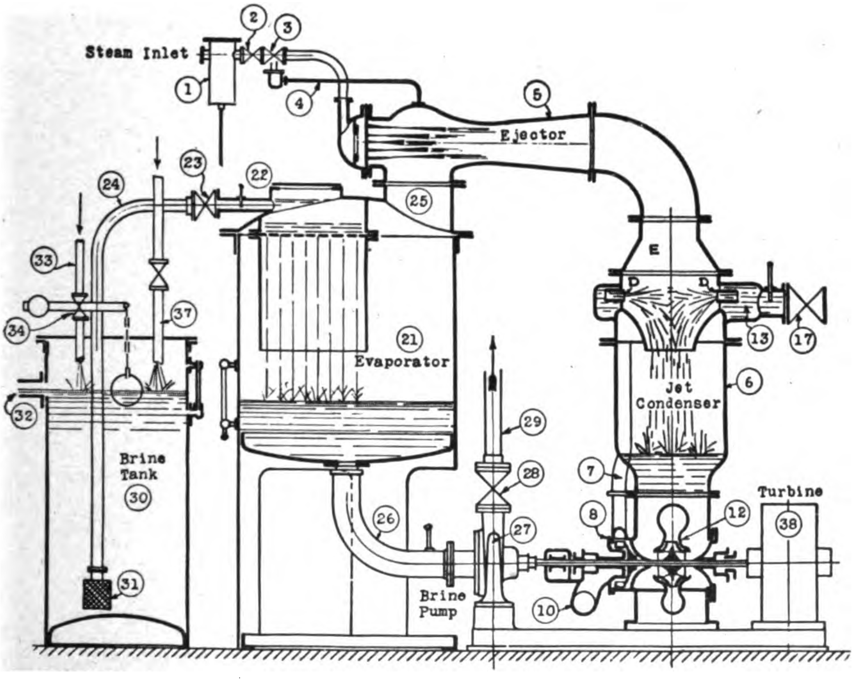


FIG. 1.—DIAGRAMMATIC ARRANGEMENT OF WESTINGHOUSE-LEBLANC REFRIGERATING MACHINE.

As has been previously explained in these columns, practically all modern refrigerating machines employ an easily compressible gas, such as ammonia, carbon dioxide, etc., and obtain the cooling action by first compressing the gas, cooling to a resulting liquid, and then permitting it to evaporate under reduced pressure. But the simple evaporation method has much to commend it in its simplicity and its independence of special chemicals and high pressures, for which reason numerous attempts have been made to utilize it commercially. None of these were successful, however, until Maurice Leblanc solved the problem and designed a new type of refrigerating machine which is now being manufactured by the Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

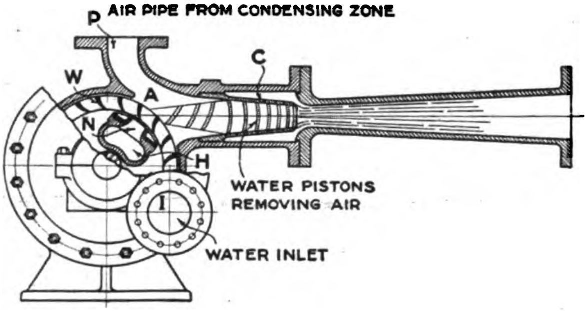


FIG. 2.—CROSS-SECTIONAL VIEW OF AIR PUMP SHOWING PRINCIPLE OF OPERATION.

The operation of this machine can be readily understood by reference to the diagram, Fig. 1, in which 30 is a storage tank for brine, 21 a large vessel called an evaporator, 6 is a condenser, and 8 is an air pump. The air pump maintains a high vacuum in the whole system beyond valve 23 between the brine tank and the evaporator. It is evident that when valve 23 is opened brine will be drawn into the evaporator, where, passing through a sieve at the top, it falls in the form of a fine spray. Since the pressure within the evaporator is very low much of the brine will evaporate instantly. In doing so it must absorb heat and since there is no other source for this heat except that part of the brine that did not evaporate, the portion that collects in the bottom of the evaporator has a low temperature. This is the refrigerant. It is pumped out by pump 27, run through pipes to wherever the cooling effect is wanted, and finally returned to tank 30.

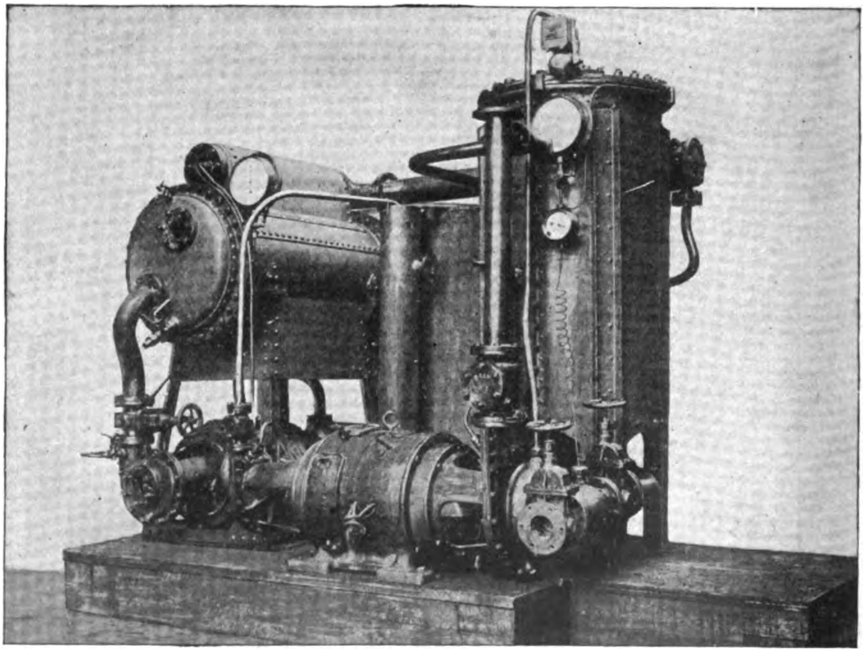


FIG. 3. WESTINGHOUSE-LEBLANC REFRIGERATING MACHINE READY FOR OPERATION.

The effectiveness of the operation depends, of course, in keeping a high vacuum within the evaporator and the evaporated spray would soon destroy this vacuum if it were not promptly removed. This is accomplished in a unique way by having the vapors rising from the evaporator meet a jet of steam from an ejector at the top of the outlet pipe; this jet sweeps the vapors into the condenser where both steam and vapors are condensed. The condenser can be of any type, jet, barometric, or surface, to suit the conditions of the installation.

Failure of previous attempts to use the principle of evaporating water was caused by the fact that no air pump could be found that would maintain continuously the necessary high vacuum. The air pump 8, is therefore a very essential element in the success of the brine evaporating machine. An enlarged diagram of this pump (an earlier invention of Mr. Leblanc) is shown in Fig. 2. It closely resembles an ordinary centrifugal pump except that it has two inlets, one for air and one for water, (7 and 10 in Fig. 1). The water is discharged by the rotating runner in the form of detached pistons which carry the air out with them. Since there is no opportunity for back leakage in this pump, it creates and holds a high vacuum without difficulty.

The Westinghouse-Leblanc refrigerating machine is made in a variety of sizes and styles for all kinds of refrigerating service, water cooling, air cooling, ice making, etc. Requiring no compressor it is economical in space and weight over the ordinary refrigerating machine, and its efficiency is stated to be proved by tests to be fully as high. It is evidently simple to operate and requires little attention being, at the same time, safe because it uses neither a dangerous gas nor a high pressure.

Small Refrigerating Units.

1.—JOHNS-MANVILLE A-S MACHINE.

One of the small machines suitable for household and small demands is the well-known Audiffren-Singrun refrigerating machine or, as it is more easily termed, the Johns-Manville A-S machine.

In brief its characteristics involve the use of a small amount of power (generally electricity), can be operated by any unskilled person, is hermetically sealed requiring no re-charging, operates on the compression system using sulphur dioxide as the refrigerating agent and never requires lubrication except for the two bearings which carry the machine.

The machine itself is simply a shaft carrying at one end a drum and at the other a pulley; in the middle of the shaft a second drum is hung. The general external appearance is strongly suggestive of a large dumbbell as shown in Fig. 1 and when erected ready for operation the end drum is partially submerged in the liquid to be cooled—usually brine. The middle or condenser drum is also partially submerged in another tank, this drum being in contact with the cooling water which must be kept running during the operation of the machine in order to carry away the heat.

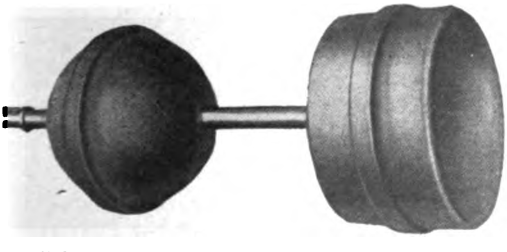


FIG. 1.—THE JOHNS-MANVILLE A-S REFRIGERATING MACHINE.

The compressor hangs loose on the shaft inside the condenser drum, being held in proper position by a counterweight which in itself automatically determines the amount of pressure which can be produced with the compressor. A cross-section of the compressor end of the dumbbell is shown in Fig. 2 and its method of operation may be described as follows:

OPERATION OF A-S MACHINE.

On the shaft inside of the drum at the middle of the shaft hangs a double-acting, two-cylinder compressor. This compressor has its suction connected to the cold or refrigerating drum through one of two passages in the shaft. As the machine revolves, the compressor, which is held down by a counter-weight, draws gas from the refrigerating end of the machine, thereby reducing the pressure in the refrigerating end and causing the sulphur-dioxide liquid to evaporate, thereby producing refrigeration. The gas which has been drawn away from the cold end of the machine is discharged into the spherical drum within which the compressor is itself located. In this drum it is condensed by contact with the walls which are in turn cooled by the condensing water, and the liquid, being held out by centrifugal force against the periphery of the machine, is caught by a spoon or scoop and drags it down to a cup at the top of the compressor where the oil is separated and sent back over the compressor, while the liquid sulphur dioxide is passed by means of a float valve back to the cold end of the machine ready to re-evaporate. Devices are also provided in the cold end of the machine for returning any oil that may accumulate in this side of the machine back to the high pressure side.

In case the condensing water gives out, the counter-weight will not hold the compressor in position beyond the time when the condensing pressure rises to a certain predetermined level. When this occurs, the counter-weight allows the compressor to revolve with the machine and, therefore, the pressure cannot rise, due to the action of the machine, beyond a certain fixed point. In this way it is impossible to cause dangerous pressures in the apparatus.

There are no joints, no stuffing boxes and no gauges to watch. All the operator needs to do is to revolve the machine and keep the condensing water flowing. The machine is frequently arranged with automatic control so that a thermostat starts and stops the apparatus in accordance with the temperatures existing in the material or compartment being cooled.

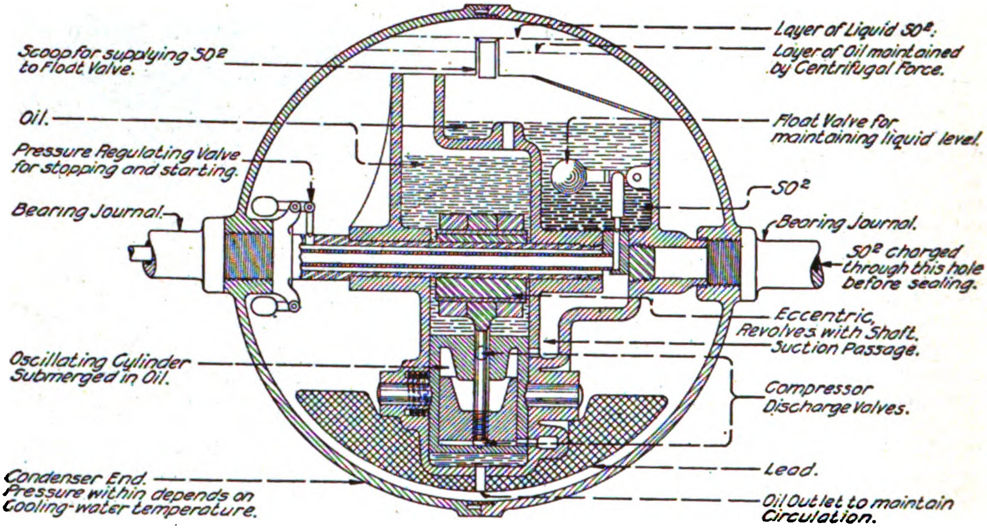

Layer of Liquid SO²
Layer of Oil maintained by Centrifugal Force.
Scoop for supplying SO² to Float Valve.
Oil.
Float Valve for maintaining liquid level
Pressure Regulating Valve for stopping and starting.
SO²
Bearing Journal.
Bearing Journal.
SO² charged through this hole before sealing.
Eccentric, Revolves with Shaft.
Suction Passage.
Oscillating Cylinder Submerged in Oil.
Compressor Discharge Valves.
Lead.
Condenser End. Pressure within depends on Cooling-water temperature.
Oil Outlet to maintain Circulation.

FIG .2.—CROSS-SECTION OF COMPRESSOR END OF JOHNS-MANVILLE A-S REFRIGERATING MACHINE.

In the process of the construction of the dumbbell the air is entirely exhausted therefrom and a charge of sulphur dioxide and a neutral oil is injected, the drums being then permanently sealed. During operation the working parts of the machines are lubricated by the pressure in the condenser which constantly forces the oil between the working surfaces. As air is not present inside the drums oxidation of the oil cannot occur.

These machines may be obtained in four standard sizes—or multiples thereof—the single unit sizes being as follows:

No.	Rating—Tons (Approximate)	Ice per Hr. lbs.	K.W. per hr.	Water, Gal. Per min.
2	1/5	11	0.6	0.75
4	1/2	27	1.25	1.66
3	1	55	2.25	3.25
6	2	110	4.50	6.5

A view of the A.S. machine set up ready shown in Fig. 3; in this drawing the ice is for ice making and refrigerator cooling is made in the ice cans I set in the ice tank IT which is partially filled with brine B The dumbbell is driven by the motor M and operates the circulating pump P which circulates the brine from beyond the ice cans through the pump suction line PS and the pump discharge line PD to the refrigerator and back to the ice tank underneath the refrigerating end of the dumbbell. The condenser C contains the cooling water (supplied through the cold water line CW) and the compression end of the dumbbell; the cooling water gradually runs off to waste through the waste pipe W.

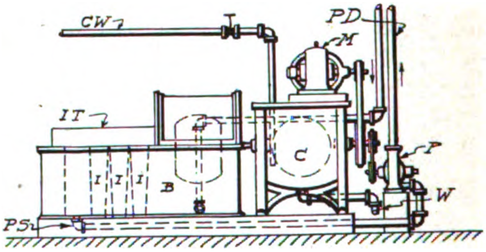


FIG. 3—JOHNS-MANVILLE A-S MACHINE SET UP.

A new booklet on the "Economy of Patented Cold Storage Doors" has just been issued by the Jamison Cold Storage Door Co. of Hagerstown, Md.

A Challenge to Service

Engineers Face to Face with a Crisis in Connection with Adequate Remuneration for their Services.

By F. H. NEWELL,

Head of Civil Engineering Department, University of Illinois, Chairman Committee on Engineering Co-Operation, American Association of Engineers.

Today we as engineers are face to face with a crisis in our affairs, second in importance to us individually only to the work of winning the war. The majority, whether members of engineering societies or outside them, are wage earners, though we love to camouflage this hard fact, under the more attractive term of salaried men.

This crisis is the inevitable result of the steady, long-continued decline in the standard of money value, the shrinkage in the purchasing power of the dollar, reflected in the commonly accepted term "The high cost of living." Our wages fixed by law or custom, suited to the conditions of years ago when the dollar had twice its purchasing power, are now inadequate. Our savings accumulated by self-denial are worth only about half what they were when we in youth put the money in the bank. Even with the added interest we can buy fewer of the necessities of life. We are practically poorer though we have observed the rules of thrift, unless—as few have done—we have been so fortunate as to invest in things to sell. Then we discover that we have made a double profit due to this same shrinkage of our measuring stick.

Others of our fellow wage earners, men who have invested little, if anything, in education, who have the most rudimentary training, who are employed as day laborers under our direction, are getting larger rates of pay. We have come to regard as a matter of course the anomaly that the engineer or trained assistant in charge, the man who is supposed to supply the training and exercise judgment is getting less than the carpenter, mason, or plumber working under his orders. Yet he must—according to our tradition—live in a little better house and maintain his family and educate his children in a more expensive way.

It is getting harder and harder to do this, and now the breaking point is about reached. Some are solving the difficulty by actually going into manual occupation. Men who have been assistant engineers in charge have found that they can get better wages by taking up the saw and hammer and entering the ranks of day labor.

The question is why do not more go, leaving this relatively poorly paid profession.

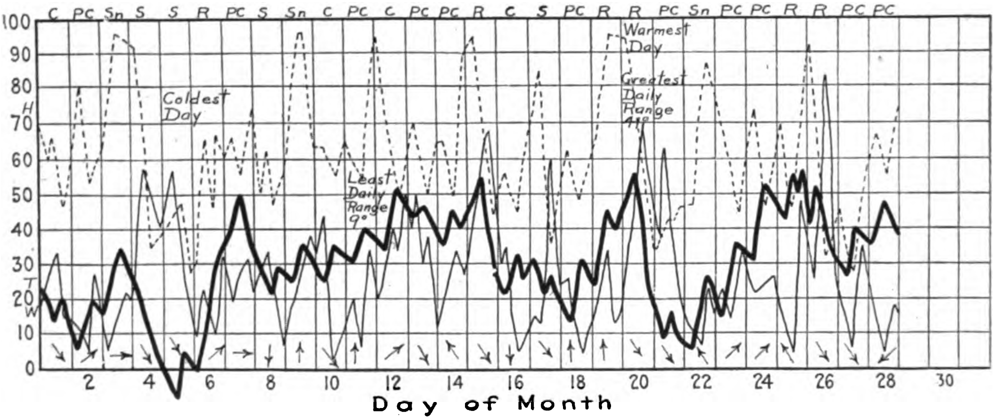
But should this be permitted? Is there not some way by which the sunlight of publicity can be turned into the dark corners of under-payment? Is it necessary that each for himself must solve the problem and single-handed struggle against a condition which is nation wide? What are others doing under the circumstances? The architects, the doctors, the lawyers, have increased their rates through the action of their organizations. It goes without saying that united labor has been heard and the response has been immediate, but what about the various associations of engineers? We have, it is true, no one all embracing society, comparable to that of European countries, nevertheless our societies are well organized and powerful if they choose to utilize their forces. What have they done or what are they proposing to do? The challenge for service to the membership lies before them.

The reply is "we were not created for any such purpose." Our rules and traditions confine us to the discussion of technical papers, relating to materials, or to the forces of nature, not to human factors. Our business is to maintain a high professional standard through lectures and publications and not through considering the condition of our members.

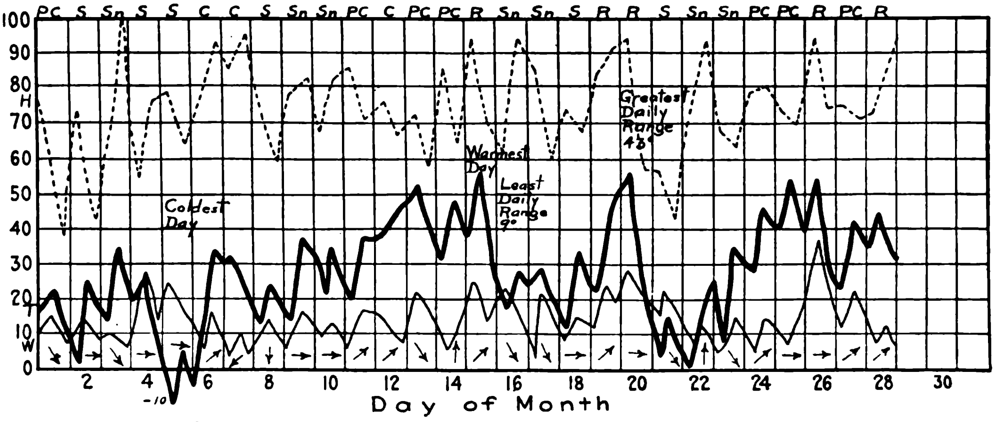
These members, however, are beginning to ask the question as to whether this is the correct or proper reply. They are realizing that times have changed and that while the engineering societies at their inception may have included a larger proportion of independent engineers, they now have a membership made up of 75% or more of wage earners. They are asking whether under this condition, where they are paying the great part of the expense of the societies, they should not receive some return directly or indirectly, other than through scientific publications.

The Weather for February, 1918

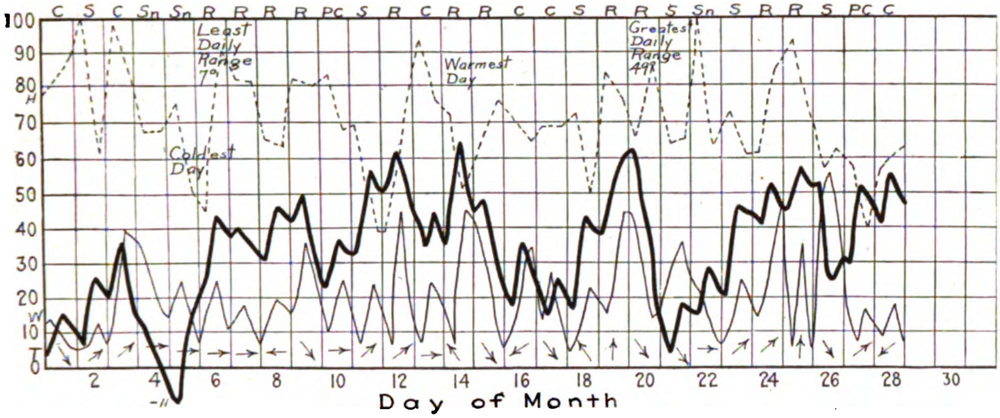
	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest temperature, degrees F	58	57	64	61	70
Date of highest temperature	20	15	14	14	19
Lowest temperature, degrees F	—7	—10	—11	—10	2
Date of lowest temperature	5	5	5	4	4
Greatest daily range, degrees F	41	43	49	38	51
Date of greatest daily range	20	20	20	19	19
Least daily range, degrees F	9	9	7	4	6
Date of least daily range	11	16	7	28	27
Normal temp. for month, degrees F	29.6	27	33	27.2	35.6
Mean normal temp. for month, degrees F	30.7	28	31.8	25.4	33.5
Total rainfall, in	1.98	2.3	1.87	2.81	2.09
Total snowfall, in	3.5	5.7	2.3	8.4	0.2
Normal precipitation, this month, in	3.74	3.44	2.66	2.16	2.75
Total wind movement, miles	14555	8221	9506	9386	11243
Average hourly wind velocity, miles	21.7	12.2	14.1	13.9	16.7
Prevailing direction of wind	N. W.	S. W.	S. W.	S. W.	S.
Number of clear days	5	6	7	6	12
Number of partly cloudy days	13	13	5	13	7
Number of cloudy days	10	9	16	9	9
Number of days on which rain fell	6	5	10	7	6
Number of days on which snow fell	3	7	3	6	1
Snow on ground at end of month, in	None	Trace	None	2.6	None



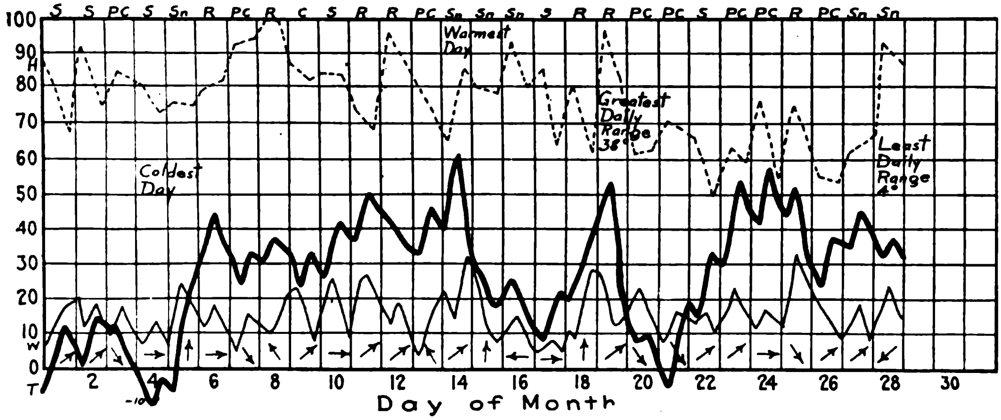
RECORD OF THE WEATHER IN NEW YORK FOR FEBRUARY, 1918.
(Hourly Observations of the Relative Humidity are Plotted on this Chart.)



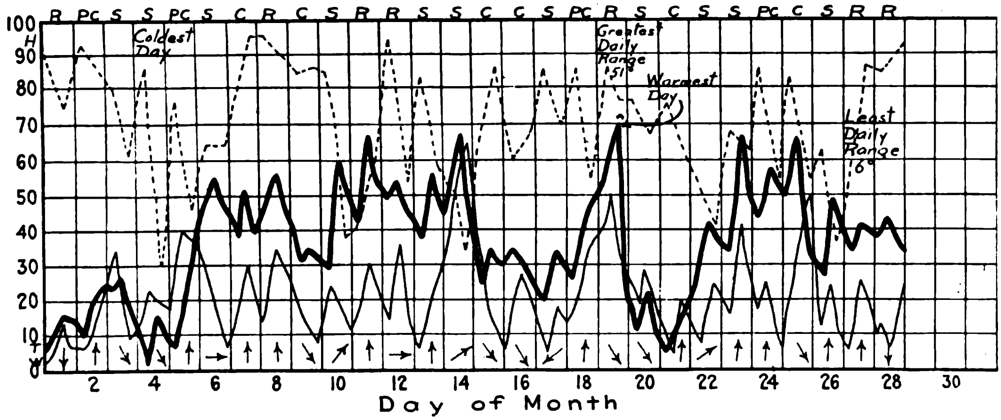
RECORD OF THE WEATHER IN BOSTON FOR FEBRUARY, 1918.



RECORD OF THE WEATHER IN PITTSBURGH FOR FEBRUARY, 1918.



RECORD OF THE WEATHER IN CHICAGO FOR FEBRUARY, 1918.



RECORD OF THE WEATHER IN ST. LOUIS FOR FEBRUARY, 1918.

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.

Heavy lines indicate temperature in degrees F.

Light lines indicate wind in miles per hour.

Broken lines indicate relative humidity in percentage from readings taken at 8 A. M. and 8 P. M.

S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.

Arrows fly with prevailing direction of wind.

The War and the Heating Engineer

The Liberty Loan Honor Flag.

A new and distinctive feature will be introduced in the Third Liberty Loan campaign, and every city or town in the country which subscribes more than its quota of Liberty bonds will be awarded by the Treasury Department an Honor Flag.

The flag will be 36 in. wide and 54 in. long. The body of the flag will be white with a broad red border, and three broad blue vertical stripes denoting the Third Loan. The flags which will be of the same quality as the flags of the Navy, are already being manufactured and will be awarded as fast as the right to fly them is won. Though awarded by the Treasury Department, they will be distributed by the Liberty loan committees of the different districts.

There will also be a National Honor Flag for each State, to be flown at the State capitol, with the name of each town winning a flag inscribed upon it. There will be also preserved in the United States Treasury a National Honor Flag, with the record of each State recorded on it.

Stars, to be placed on the flag of each city or town doubling its quota, will be also awarded, and an additional star for each time the quota is doubled.

An Honor Roll, containing the names of all subscribers, but not the amount of the individual subscriptions, will be kept in each community. A window card, bearing a representation of the Honor Flag, will be given each subscriber to the loan, to be displayed at the home or place of business.

Extensions of Army Cantonments.

With the coming of Spring the work of rounding out the construction of the great army cantonments is commencing to occupy the attention of engineers and contractors. The success with which the hastily-constructed camps met the phenomenally severe test of the past winter is well known, but it has also been well understood that as soon as opportunity offered the cantonment quarters would be placed on a more permanent basis.

At Camp Custer, located at Battle Creek, Mich., work has already begun on the enlargement of the base hospital. This is the first step of a Spring building drive which will not only double the camp's capacity, but will include the brick veneering of many if not all of the buildings, together with changes in the heating system.

The necessity for the latter changes lies in the demonstration during the winter that much fuel was wasted and steam lost because of exhaust steam pipes led from the barracks into the open. The proposed change calls for the installation of a return system.

One of the reasons for extending the Northern barracks is that the soil formation in the South is unsuited for training and many of the soldiers in the Southern training camps will be moved North.

Emergency Fleet News.

The accompanying illustration shows the metal badge given to every volunteer for service in the shipyards. The badges are being distributed as fast as they can be sent out from Washington.

SHIPYARD SERVICE BADGE
ISSUED BY GOVERNMENT.

With the advent of the volunteer workers, Uncle Sam will have about 450,000 skilled men actually at work in shipyards. That shows what can be done in a little over a year's time. The following figures speak for themselves. In 1916, the wage-earners in steel shipyards of the country numbered:

Steel shipyards	43,582
Wood shipyards	1,380
Total	44,962

On January 1, 1918, the workers numbered:

Steel shipyards	181,273
Wood shipyards	23,437
Total	204,710

Add the 250,000 men who will respond to the call for shipyard volunteers and the grand total when we get into full swing will be 454,710 shipbuilders.

A feat that is amazing to the layman is being performed on the Great Lakes, where mighty ore carriers that ply ordinarily between Duluth and the ports of Lake Erie are being cut in two so they may pass through the Welland Canal to the Atlantic and put into service in war trade. It is impossible for these vessels to be taken through the canal as they were built. Engineering science solved what would seem to the layman an insurmountable problem. These monster vessels are divided in the middle by an acetylene flame; the open end inclosed and half of the ship is taken through the canal. The other half follows and, in the St. Lawrence, the two are joined together again.

Legislation for Central Control.

Pending action by Congress on the enactment of laws to bring about a more central control and responsibility for procuring war material and supplies, the Chamber of Commerce of the United States is engaged in developing plans which it will recommend for the reorganization of the several Government departments affected. The Chamber of Commerce is in favor of dropping the agitation for a ministry of munitions and a war cabinet on account of the opposition to this measure by the Administration and now favors the idea of radically changing the existing machinery to bring about the desired central control and responsibility. To this end support is urged of the so-called Overman bill which authorizes the President to rearrange the distribution of war activities between the executive bureaus and departments and to employ, if necessary, additional agencies.

Higher Salaries for Government Technical Men.

The American Association of Engineers has inaugurated a movement to secure higher salaries for technical men employed by the railroads now under the control of the Government. The appeal is being made to the United States Government Wage Commission and the association points out that all engineers will be indirectly benefited by such an increase. It has been found that the average monthly salary for a draftsman is $90.00 per month, the salaries running up to $150 for division engineers. The increase urged by the association is 50% additional to the present salaries.

American Business Men Discuss War Questions.

As we go to press the sixth annual meeting of the United States Chamber of Commerce is being held in Chicago, the dates being April 10-12. Business readjustment to war is the dominant note of the meeting. The four critical questions of the day—financing the war, railroads, centralized control of industry and shipping, are being considered from the two-fold point of view of filling the government's requirements with the minimum disturbance to private industry.

Why Moving Clocks Ahead Will Help Win the War.

Now that the Daylight Saving plan has become a reality, its effect on the daily lives of practically all of us forms a topic of the liveliest interest. From the heating engineers' standpoint the principal effect of the scheme is in the immediate reduction in the use of light and heat, with its attendant conservation of coal. More than 1,500,000 tons of coal a year is the estimated saving and the saving in fuel oils is equally impressive.

Calculations computed for different periods based upon the actual British experience in the summer of 1916, and modified by allowances for differences in latitude give the following savings in coal for the United States:

(1) Saving of 150 hours of a yearly average of 1320 per year requiring artificial illumination in the U. S. (i. e., by daylight saving between second Sunday in April and last Sunday in September):

In electricity for lighting	660,000 tons coal
In gas for lighting.....	144,000 tons coal
	804,000 tons coal
(2) Saving of 190 hours from the yearly average (i. e., with clocks moved ahead one hour between April 1 and November 30):	
In electricity for lighting	836,000 tons coal
In gas for lighting.....	183,000 tons coal
	1,019,000 tons coal
(3) Saving of 198 hours from the yearly average (i. e., with clocks advanced one hour throughout year):	
In electricity for lighting	871,000 tons coal
In gas for lighting.....	190,000 tons coal
	1,061,000 tons coal

These figures do not include the saving which would be obtained at isolated plants and at electric power plants which sell power for lighting: To be borne in mind, too, is the fact that the estimate has been made on a basis which assumes the use of electric energy and gas for lighting is spread evenly over the country whereas as a matter of fact 57,000,000 electric lights out of a total of 76,000,000 in the country are in New England, Middle Atlantic and Northern Central states where the advantages of daylight saving will be most striking.

The saving of coal through substitution of a morning hour of moderate illumination for an evening hour of maximum use of electricity and gas illustrates ways in which very important savings in coal would be obtained.

For example, take the Commonwealth Edison Company of Chicago. The peak load of this company is needed for no more than one and one-half hours a day. The average load is less than 50% of the peak. The investment and equipment to produce the peak is upwards of one-fourth of the whole and equals $25,000,000. Daylight saving will do two very important things for this and similar companies. First, it will materially reduce the peak load required for domestic and industrial lighting; second, it will place the greatest demand for power for transportation farther within the hours of natural light in place of having it simultaneous with the high demands for artificial light as it is under present conditions during many months of the year.

In addition to a saving of coal amounting to hundreds of thousands of tons, daylight saving will also enable these companies to postpone new investments in equipment to carry the peak of the load which would amount to millions of dollars. This postponement will come at a time when it is of the highest public interest to avoid all new financing that is possible. The situation of the Commonwealth Edison Company is typical. In 1916 it had a generating capacity of 360,000 kilowatts. At the end of 1917 it had increased this to 452,000 and according to plans made it will, under present conditions, have to raise this to 600,000 kilowatts by the end of 1919. Such growth is not abnormal and may be said to be typical of scores of similar companies throughout the country. The new order will enable them to conserve capital which would otherwise be spent in extending their equipment.

Heating Men in Military Service.

H. E. Sproull, formerly manager of the Dallas and Salt Lake City branches and assistant manager of the Cleveland office of the American Blower Company, has received his commission as first lieutenant, C. A. R. C., at Fortress Monroe, Va. He has been assigned to Battery D, 64th Heavy Artillery, at Jackson Barracks, La.

Oversubscribed.

The issue of $500,000,000 of United States Treasury certificates, the subscription to which closed March 5, was oversubscribed, the subscription in every district, except one, exceeding the quota assigned it.

The banks of the country in the past two Liberty Loan campaigns and in the purchase of Treasury certificates issued before the loans responded to the demands of the country with inspiring loyalty and liberality. The faith they show in the Government finances and the patriotic response they give to the calls of the Treasury are certain indications that their cooperation and assistance will help to insure the success of the Third Liberty Loan.

American and English Income Taxes.

In comparison with the tax levied in England on incomes our own income taxes are moderate, indeed.

In England the tax on incomes of $1,000 is 4½%, in America nothing.

In England the tax on incomes of $1,500 is 6¼%; in America nothing for married men or heads of families, and 2% on $500 for an unmarried man.

In England the tax on an income of $2,000 is 7⅞%; in America nothing for a married man or head of a family, and 2% on $1,000 for unmarried men.

The English income tax rate also increases more rapidly with the growth of the income than ours, a $3,000 income being taxed 14%, $5,000 16%; $10,000 20%, and $15,000 25%, while our corresponding taxes for married men are respectively two thirds of 1%, 1½%, 3½% and 5%, and only slightly more for the unmarried, due to the smaller amount exempted, the rate being the same.

Clean Coal the Key to the Fuel Problem.

E. G. Bailey, president of the Bailey Meter Co., Boston, Mass., was one of the lecturers in the J. E. Aldred lecture series at the Johns Hopkins University, Baltimore, Md., February 28. Mr. Bailey's subject was "The Coal Problem." After discussing the coal troubles of the past winter which, he stated, were greatly aggravated by the poor quality of coal delivered, Mr. Bailey proposed as a remedy that standards of quality be established for coal and that a premium be offered for clean coal.

"The price paid to the operator," he said, "should be based on standards established by the Fuel Administration according to different mining districts, etc., with premiums based almost entirely upon percentage of ash, and especially the free ash as slate and rock which can and should be eliminated at the mines.

"Coal-sampling stations should be established by the Government at certain central points where large quantities of coal are received direct from mines such as New York, Philadelphia, Baltimore, Hampton Roads and the lake loading ports, each station being equipped with machinery for obtaining representative samples from as many individual cars as necessary to determine the average quality of coal shipped from each mine during each month.

LOAD CARS WITH THE CLEANEST COAL

"The operator would not know what cars were to be sampled, for the Fuel Administration could consign or reconsign any cars in transit to the coal piers or power houses where the sampling stations were located. The mine operator would therefore have a real incentive to load every car with as clean coal as possible.

The car distribution at the mines, which is an important point to the operator, should also be based upon the quality of coal produced so that there would be an added incentive to load clean coal, and the market would always be supplied with a greater proportion of the better quality of coal, than if the empty cars were prorated equally among the poorer and better mines as at present.

"Actual knowledge of the quality of coal would also be of great benefit to the Fuel Administration in classifying various mines into pools so that the consumer and particularly the railroads would receive coal of uniform quality, thereby enabling them to obtain maximum capacity and efficiency in the combustion of this coal.

"There is sufficient labor at the mines to clean the coal, and the railroads can haul enough good coal, but they cannot get the necessary heat units to the consumer if they must be burdened with hauling 30,000,000 tons of unnecessary dirt. We have our choice of either building thousands of locomotives and a hundred thousand cars and adding to the terminal facilities of our railroads within the next few months or removing the excessive impurities from the coal. The latter can be done quickly and effectively. It is the only feasible remedy for our present coal problem."

Success of America's War-Savings Campaign.

For their respective first three months the American war-savings campaign is running ahead of the English campaign. America is pouring into the Treasury at the rate of about $2,000,000 a day—over $75,000,000 up to date.

The direct comparison is:

	ENGLAND	AMERICA
First month......	$ 5,172,000	$10,236,451
Second month....	2,719,000	24,559,722
Third month.....	3,402,000	41,148,244
Total........	$11,293,000	$75,944,417

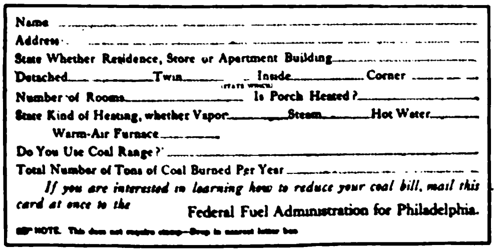
The $75,944,417, of spending already put at the service of the Government by the buyers of war-saving securities has transferred from millions of patriotic, saving citizens to the National Treasury command of the labor and materials to build a fleet of about one hundred 5,000-ton ships.

How to Place Tracing Cloth at Service of the Red Cross.

A new appeal for discarded draftmen's tracing cloth is being sent out by the American Red Cross. It is stated that this cloth can easily be handled by modern laundries. Manufacturers, architects and engineers are asked to call up the local laundry owners' association or one of the large laundries of his city and he will find the laundrymen glad to send for such cloth as they have on hand. Some of the tracing cloth is thin linen fabric and some is thin cotton but either one makes no difference in the washing process. The cloth has been treated with a gelatinous dressing to make the material take ink and at the same time be transparent. Malt extract, or diastase, is used in the laundries to remove this dressing, although a cold rinse, followed by a hot suds, will serve. The goods are given a fairly strongh bleach, followed by a sour, to remove traces of bleach. Then there should be a good rinse, to remove every trace of the sour. The bleach, it is pointed out, will completely sterilize the goods.

Philadelphia Heating Trade Establishes Coal-Saving Stations.

A remarkable movement to teach the principles of fuel conservation has been inaugurated in Philadelphia under the direction of a committee of men in the heating and coal industry, known as the Committee on Practical Fuel Conservation of the Federal Fuel Administration. Already fifteen instruction stations have been opened in different parts of the city and have attracted large numbers of people. None of the instructors is allowed even to suggest what is the best heating apparatus nor are any of them permitted to mention his own name or that of the manufacturer. At least one instructor is always at each station ready and willing to answer questions in regard to the saving of fuel.



Name

Address

State Whether Residence, Store or Apartment Building

Detached Twin Inside Corner (STATE WHICH)

Number of Rooms Is Porch Heated?

State Kind of Heating, whether Vapor Steam Hot Water

Warm-Air Furnace

Do You Use Coal Range?

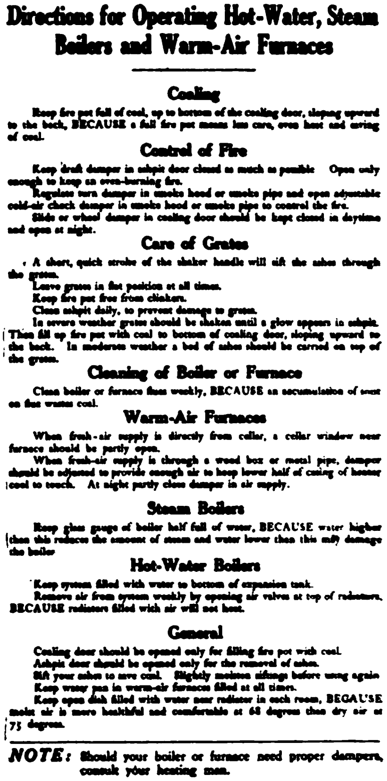
Total Number of Tons of Coal Burned Per Year

If you are interested in learning how to reduce your coal bill, mail this card at once to the Federal Fuel Administration for Philadelphia.

NOTE. This does not require stamp—Drop in nearest letter box

POST CARD SENT OUT BY FEDERAL FUEL ADMINISTRATION OF PHILADELPHIA.

Printed instructions are handed out for operating boilers, warm-air furnaces and coal cooking ranges. The boiler-operating rules are reproduced herewith, together with one of the posters published by the Federal Fuel Administration for Philadelphia.



Directions for Operating Hot-Water, Steam Boilers and Warm-Air Furnaces

Coaling

Keep fire pot full of coal, up to bottom of the coaling door, sloping upward to the back, BECAUSE a full fire pot means less care, even heat and saving of coal.

Control of Fire

Keep draft damper in ashpit door closed as much as possible. Open only enough to keep an even-burning fire.

Regulate turn damper in smoke hood or smoke pipe and open adjustable cold-air check damper in smoke hood or smoke pipe to control the fire.

Slide or wheel damper in coaling door should be kept closed in daytime and open at night.

Care of Grates

A short, quick stroke of the shaker handle will sift the ashes through the grates.

Leave grates in flat position at all times.

Keep fire pot free from clinkers.

Clean ashpit daily, to prevent damage to grates.

In severe weather grates should be shaken until a glow appears in ashpit. Then fill up fire pot with coal to bottom of coaling door, sloping upward to the back. In moderate weather a bed of ashes should be carried on top of the grates.

Cleaning of Boiler or Furnace

Clean boiler or furnace flues weekly, BECAUSE an accumulation of soot on flue wastes coal.

Warm-Air Furnaces

When fresh-air supply is directly from cellar, a cellar window near furnace should be partly open.

When fresh-air supply is through a wood box or metal pipe, damper should be adjusted to provide enough air to keep lower half of casing of heater cool to touch. At night partly close damper in air supply.

Steam Boilers

Keep glass gauge of boiler half full of water, BECAUSE water higher than this reduces the amount of steam and water lower than this may damage the boiler

Hot-Water Boilers

Keep system filled with water to bottom of expansion tank.

Remove air from system weekly by opening air valves at top of radiators, BECAUSE radiators filled with air will not heat.

General

Coaling door should be opened only for filling fire pot with coal.

Ashpit door should be opened only for the removal of ashes.

Sift your ashes to save coal. Slightly moisten siftings before using again

Keep water pan in warm-air furnaces filled at all times.

Keep open dish filled with water near radiator in each room, BECAUSE moist air is more healthful and comfortable at 68 degrees than dry air at 75 degrees.

NOTE: Should your boiler or furnace need proper dampers, consult your heating man.

RULES FOR OPERATING HEATERS ISSUED BY PHILADELPHIA COMMITTEE ON PRACTICAL FUEL CONSERVATION.

The chairman of the executive committee is H. D. Kellogg, of the H. B. Smith Company and the other members are T. C. Mahady, secretary; W. A. Bland C. P. Hackett, C. V. Haynes, E. S. Berry B. F. Johns, A. C. Mott, H. W. Plucker and W. E. Tinker.

The general committee is made up o the following firms:

Abram Cox Stove Co.
American Radiator Co.
Bridgman Bros. Co.
Borden Stove Co.
Crane Company
Continental Heater Co.
Dunham Co., C. A.
Federal Radiator Company
absorbed by National Radiator Co.

LEARN HOW

BY VISITING ANY

INSTRUCTION STATION

OUR TRANSPORTS BURN IT INSTEAD OF SOFT COAL TO PREVENT DISCOVERY BY SUBMARINE

TWO SHOVELS OF COAL SAVED DAILY IN PHILADELPHIA HOMES MEANS

100.000 TONS SAVED MONTHLY

FEDERAL FUEL ADMINISTRATION

POSTER ON FUEL CONSERVATION SENT OUT BY THE FEDERAL FUEL ADMINISTRATION OF PHILADELPHIA.

Fleck Brothers Co.
Fowler & Wolfe Mfg. Co.
Gurney Heater Mfg. Co.
Hart & Crouse Co.
Haynes Selling Company
Johnson Co., J. D.
Keystone Supply & Mfg. Co.
Lord & Burnham Co.
National Radiator Co.
Pierce, Butler & Pierce Rad. Co.
Page Boiler Co., W. H.
Richardson & Boynton Co.
Richmond Radiator Company
Smith Co., H. B.
Spear Stove & Htg. Co.
Sheppard Co., Isaac A.
Spencer Heater Co.
Union Radiator Co.
United States Radiator Co.
Vapor Vacuum Co.
Warren Webster Co.
Warm Air Heating Asso.
Williamsport Radiator Co.

The Uses of Coal in the United States.

In his address at the recent annual meeting of the heating engineers' society on coal conservation, Professor L. P. Breckenridge showed a number of lantern slides giving statistics of the coal industry in the United States. One of the most interesting was one on the uses of coal in the United States for 1910. For bituminous coal these figures are:

	TONS
Industrial steam trade	143,765,500
Railroads	122,000,000
Domestic and small steam trade	71,338,489
Beehive coal	42,278,516
By-product coke	19,554,382
Exported	18,773,782
Steamship bunker fuel	10,707,507
Steam and heat at mines	9,798,681
Coal gas	4,563,579

For anthracite, the figures are:

Domestic	47,338,100
Steam	31,560,400
Railroads	6,200,000
Exported	3,965,255

The New Rules for the Sale of Coal and Coke.

In connection with the recent order of the United States Fuel Administration regulating the making of contracts by operators, producers and jobbers of coal and coke, the Wholesale Coal Trade Association of New York has passed resolutions seeking to obtain a modification of the order which is characterized as leading to confusion and distress.

The resolution states that the sections of the order relating to the power of the fuel administration to cancel contracts and to the liability of requisition by the fuel administrator (Sections 4 and 5) make a contract very indefinite and that a producer can give no assurance to the consumer of the quantity of coal that he will receive under such a contract. A request is made that the fuel administration modify the above-mentioned clauses so as to make it possible for the producer and owner of coal to make binding contracts with consumers and manufacturers, if necessary, naming the essential consumers and limiting the quantity of coal to be sold to non-essential consumers in such manner as may be found needful and proper after investigation by the fuel administration.

CORRESPONDENCE

Novel Scheme for Heating Garage.

EDITOR HEATING AND VENTILATING MAGAZINE:

I would like to make a suggestion in reply to your correspondent's request for information on heating a detached garage with hot water. About seven years ago I had the same problem and solved it as per diagram. The house was warmed by an overhead system with balanced returns. For the garage an independent main was taken from the boiler and carried to and across the basement ceiling, then down and across to the garage through a crock conduit, then in the garage up to the ceiling, forming a coil at the ceiling, then down to the radiator and back to the boiler. The idea was that the coil near the ceiling being placed near the doors, where the heat losses were the greatest, would act as a cooling coil, causing a great difference in temperature in the main. This would cause a rapid circulation and force this warm water through the feed main to the garage.

In operation it was a perfect success and in all these years it has never failed to heat the garage perfectly. The scheme has been since used by others in Saginaw. By placing valves where shown the garage circuit may be shut off at any time and all the water drained off, as the garage is on an independent circuit. I suggest this as a simpler method than piping to the attic and back again in the house in order to get to the garage.

The articles in your magazine have been of great assistance to me in my heating problems and I offer my little "bit" in the hope that you may find them of some use to your readers.

Saginaw, Mich. J. F. B.

Our correspondent's sketch is shown in Fig. 1 and illustrates another method of heating a detached garage with hot water. There is no doubt that this scheme possesses certain advantages as follows:

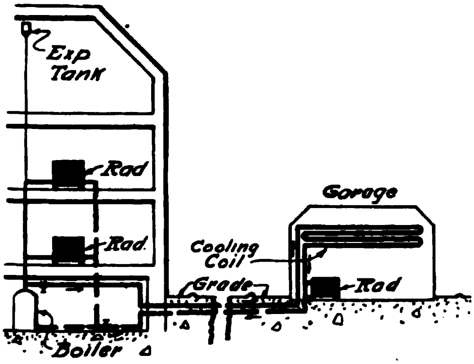


FIG. 1.—CORRESPONDENT'S SOLUTION FOR HEATING DETACHED GARAGE WITH HOT WATER FROM HOUSE SYSTEM.

No line is necessary up to the attic and back again in the house, as our correspondent has pointed out.

There is, therefore, saving of pipe and cutting.

There is less heat loss on the line—due to its shortening—and the radiation from the pipe (necessary to produce the circulation) takes place in the garage where the heat is needed, instead of in the house where it is not wanted.

The disadvantages we see consist of the following:

No automatic air vent is provided for the high part of the circulation loop on the basement ceiling.

If an air relief pipe is provided here to free this pipe from air it must be run up to the expansion tank, involving at least half the cutting and piping shown in the original scheme.

There must be two heating surfaces used in the garage (the coil and the radiator) and the coil—according to our correspondent's sketch—is in series with the circulation so that it cannot be shut off without stopping the circulation.

An air valve must be placed on the coil to relieve it from air.

The major portion of the heat from the hottest water is developed on the ceiling where it is not as desirable as when all the heat is developed at the radiator on the floor. Ceiling coils, where excessive leakage of cold air—as from the opening of doors, etc.—is encountered are never as satisfactory as surface placed near the floor.

From the foregoing we are inclined to the opinion that the scheme previously illustrated in these columns would give better results but that our correspondent's idea is a good substitute if for any structural or other reason the first arrangement cannot be used.

An Army Hospital Heating Problem.

EDITOR HEATING AND VENTILATING MAGAZINE:

The writer is preparing plans and specifications for heating a group of hospital buildings for the army. Am planning to use a direct radiation system of steam heating, distributing the steam at about 80 lbs. pressure from the boilers and reducing at each building to about 20 lbs. In order to avoid underground work as much as possible I am planning to carry the main returns overhead.

A New York engineer had done some work on this layout previous to my being placed in charge of the work and his plans call for connecting groups of radiators into a return below the floor, connecting this return into a bucket trap, and thence elevating the returns overhead, as shown on the enclosed sketch.

I am of the opinion that the steam will tend to short-circut through the radiators nearest the source of supply and prevent the proper return of condensation from the radiators near the end of the line. It has seemed to me preferable to place a thermostatic trap, and possibly a check valve on each individual radiator and elevate the condensation to the overhead return main at once.

I would like very much to have your opinion of the relative merits of the two schemes.

War Dept., Washington, D.C. B. O. P.

The system in question is illustrated in Fig. 1, but our correspondent does not furnish information on two important items, *viz.*, whether the trap discharge goes back against any pressure and whether the radiators have automatic air valves or pet cocks. As it is stated that the steam is generated at 80 lbs., we do not assume that the bucket trap at 20 lbs. will be expected to discharge

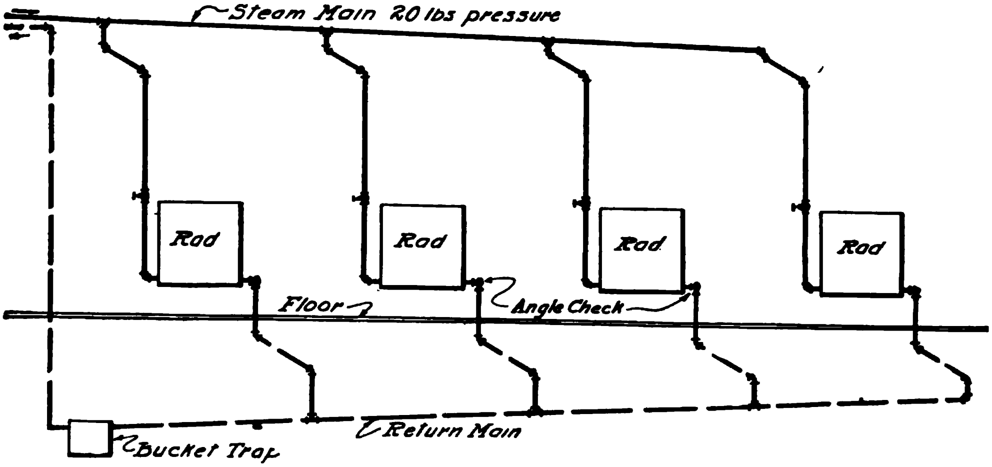


FIG. 1.—CONDITIONS OF PROBLEM FOR HEATING ARMY HOSPITAL.

directly back to the boilers, but it might go to a receiver in which pressure is carried or it might go to an open feed-water heater in which some pressure would have to be maintained. On the other hand, the return might be graded and vented so as to have no pressure on it except atmosphere.

If the trap discharge has no back pressure to operate against the bucket trap will lift the return approximately 2 ft. for every pound pressure in the return line. If the discharge goes back against a lower pressure, say 5 lbs. or so, such as would be the case if discharged into a feed-water heater, the bucket trap will lift the return approximately 2 ft. for every pound excess of return pressure over the discharge back-pressure against which the trap operates.

If the discharge goes back against the same pressure as in the steam main the trap will not lift and, in fact, will not operate at all, due to some drop in pressure occurring in the steam passing through the radiator.

To get rid of the air when the system is started up automatic air valves, pet cocks, or other devices must be used, as a bucket trap will not handle air; in fact, an air-bound trap will not handle even water as long as the bucket remains full of air. It is a question if automatic air valves will give good service when operating on 20 lbs. of steam pressure. Our experience is that above 7 or 8 lbs. leakage is liable to occur. Under the conditions given we recommend that every radiator and the trap should have a pet cock which can be shut off when the air is blown out.

Our correspondent raises the question of short-circuiting, but we believe that there is little danger of this if the steam supply branches and radiator connections are sized properly so as to prevent excessive drop in pressure in passing through the radiators, thus maintaining on the return main to the trap approximately the same pressure as on the supply main. If such conditions are maintained then the condensation from each radiator will naturally find its way down into the return line by gravity.

On the other hand, if the supply branches are not large enough to furnish the radiators with steam as fast as they condense it and with but little loss of pressure in the radiator, then the pressure in some of the radiators might drop to a lower point than the pressure in the return line, resulting in holding back the return from such radiators and even drawing up steam and water into the radiator through the return connection. The angle check called for would prevent this reverse flow, of course, but it would hinder rather than help the return leaving the radiator since a slight addition head of water would be required to open the flap of the check.

Therefore, we recommend that each radiator should have a common supply and return valve for shutting off and no short circuiting will occur with proper sizing of pipes as long as 20 lbs. of steam is kept on the radiators and the system is free of air.

If the supply pipes are too small the only remedy would be to connect each radiator return to the return main through a water seal deep enough to counterbalance any difference in pressure existing between the radiator and the main.

Reducing Velocity to Pressure.

Editor Heating and Ventilating Magazine:

Please tell me how to reduce velocity to pressure and vice versa. I have a "Kent's" handbook but due to the fact that I cannot change velocity to pressure, I cannot use the formulas. I also wish you would answer this question: in a certain power plant, the steam is used only for heating purposes. High-pressure steam is produced at 80 to 90 lbs. gage pressure, what is the loss when this steam is reduced to 5 to 6 lbs. gage for the low-pressure heating system? The heating system is a vacuum return system and, from a test run the other day, I discovered the following fact, at 10 lbs. on the heating system the feed-water came back colder than at 4 lbs. Why?

Utica, N. Y. C. A. C., Jr.

The velocity pressure of air flowing in a duct or flue under a barometric pressure of 29.92 in. of mercury is given by the formula:

$$VP = \frac{V^2}{8\frac{1}{2}\ (460 + t)}$$

when VP = velocity pressure in inches of water.
V = velocity in feet per second.
t = temperature of air in degrees F.

For example, air flowing through a duct at 1200 f.p.m. and at 100° F. temperature will have a VP of

$$\frac{1200/60 \times 1200/60}{8\frac{1}{2} \times 560} = \frac{400}{4760} = 0.084 \text{ in. of}$$

water.

The velocity pressure is useful in measuring the flow of air in ducts by means of the Pitot tube in which the static and total pressures are obtained and the velocity pressure found by subtracting the static pressure from the total pressure.

A relation can also be established in steam and compressed air lines where the velocity increases due to the reduction in pressure on the gas and the consequent expansion of same. If a case is assumed where the drop in pressure is such that the volume of 1 lb. of gas at the outlet end of the pipe were twice the volume at the inlet it follows, of course, that the velocity at the outlet end of the pipe must be double that of the inlet in order to handle the larger volume. Therefore this increase in velocity may be attributed directly to the drop in pressure and divided by the number of pounds drop the quotient would represent number of feet increase in velocity to every pound of drop.

In regard to the loss of heat when high-pressure steam is passed through a reducing valve and is reduced to a lower pressure, it may be said that if the steam pressure is reduced through a reducing valve there is little if any heat lost; if the steam pressure is reduced by being passed through an engine the heat loss will approximate 10% due to a portion of the heat being transformed into work and another portion lost by condensation within the engine. In a reducing valve the additional heat contained in the high-pressure steam goes to superheat the low-pressure steam after passing the reducing valve.

As to the returns coming back at different temperatures there is no reason why the returns on a vacuum system should come back warmer with low-pressure steam and colder with higher-pressure unless the traps on the radiators do not hold and are leaking more at the lower pressure and temperature on the inlet side. This action is often observable on the common automatic air valve used on radiators where they will leak both air and water under vapor or low-pressure conditions but will shut off perfectly tight at 5 lbs. of steam pressure or over.

Back Draft in Chimney.

Editor Heating and Ventilating Magazine:

The points made by T. W. R. in your February issue, regarding a back-draft in a chimney where three flues are connected to fireplaces, are not quite clear to me on some points. I do not see why the leaving of the door "D" open for an experiment without stopping the back-draft action, proves that the wind "does not blow on that side of the dwelling." The wind might not have been blowing on that side of the building at that particular time. Also, it must be remembered that the draft in a high flue is stronger than in a short flue for the same temperature difference between the gases and the outside air.

Although your correspondent states that a ventilator top "might effect the same results as a closed damper," I know of several cases where ventilator tops do help the draft considerably.

Neither can I see why the radiators on the basement ceiling should cause a reversal of the flue, either directly or indirectly. It is true they will make the air temperature at and near the ceiling somewhat higher and that at the floor somewhat lower than if floor radiation were used, but the increased variation of 10° between the floor and ceiling will not affect the flue action, as the radiators do not create any additional air nor do they consume any.

The suggestion to cut a register or grille into the flue at the ceiling line does not help matters for even if this established a flow in the flue in an upward direction, it would at the same time kill the draft from the fireplace just as effectually as is now the case.

New York. READER.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Arrangements for Summer Meeting.

Announcement is made that Buffalo, N. Y., has been selected as the place for holding the summer meeting of the society. The dates are June 26, 27 and 28. This will bring the meeting earlier in the summer than usual, this being done partly to accommodate the members of the National District Heating Association, as that organization will hold no meeting this year. A special session for the benefit of the central station heating industry is being planned so that members of the National District Heating Association who are invited to be present, as well as others interested, may have an opportunity to discuss matters affecting their industry.

Committees for 1918.

At a meeting of the council held March 6 the following committees were named for 1918:

Committee on Code for Testing Low Pressure Heating Boilers: Homer Addams, chairman; John R. Allen, L. P. Breckenridge, Ralph Collamore, W. L. Fleisher, James F. McIntire, J. J. Blackmore, William H. Driscoll, L. A. Harding, Edwin A. May, Walter S. Timmis and Percy H. Seward.

Committee on Engineering Co-operation: John F. Hale, chairman; E. Vernon Hill and S. R. Lewis.

Committee on Research Bureau: J. I. Lyle, chairman; Harry M. Hart, J. D. Hoffman, William F. McDonald and Perry West.

Committee on Schoolhouse Standards: Frank I. Cooper, chairman; John D. Cassell, Frank G. McCann, Robert J. Mayer and John Howatt.

Committee on Standard Method for Testing Air Washers: A. E. Stacey, chairman; Harry M. Hart and E. Vernon Hill.

Committee on Standard Method for Testing Radiators: John R. Allen, chairman; C. W. Johnson and L. C. Soule.

Committee to Confer with Bureaus of Mines: J. Irvine Lyle, chairman; G. W. Martin and Perry West.

Committee to Confer with National District Heating Association: J. Irvine Lyle, chairman; A. S. Armagnac, William H. Driscoll and C. W. Obert.

Committee to Co-operate with the United States Navy Department: Walter S. Timmis, chairman; Willis H. Carrier, E. Vernon Hill, William H. Driscoll and Fred R. Still.

Committee to Determine the Most Effective Place for a Radiator in a Room: William F. Verner, chairman; John R. Allen and Ralph Collamore.

Representative on Census Committee of Engineering Council: Champlain L. Riley.

Nominating Committee: Percy H. Seward, chairman; J. D. Cassell, H. M. Hart, Frank L. Chew and E. E. McNair.

Recent Developments in Coal Mine Ventilation Described Before New York Chapter.

A subject that proved to be of unusual interest and timeliness engaged the attention of the New York Chapter at its meeting on March 21, when Thomas Chester of the American Blower Company, gave a talk on "Coal Mine Ventilation and Its Effect on Production." After presenting a carefully-prepared paper on the subject, Mr. Chester held the close interest of the members by presenting a series of stereopticon slides showing in detail the methods followed in mining the coal, the ventilation requirements and numerous views of important blower installations for this class of work.

Mr. Chester said that multiblade fans are now used almost exclusively for mine ventilation. A properly-ventilated coal mine will result in a 10% increase in coal production. It is the usual practice to arrange the fans for supply and exhaust, suitable damper doors being provided to effect the change in the direction of air flow. In exhausting general use is made of the evasé outlet with its restricted opening, giving a venturi-tube effect and greatly adding to the efficiency of the fan. These outlets give a characteristic appearance to the mine ventilating apparatus located near the opening of the shaft, resembling to some extent the old-style locomotive smoke-stack.

The views shown by Mr. Chester included views, of metal mines in which he said, the need of ventilation is almost as great as in coal mines.

Previous to Mr. Chester's address, the members had the pleasure of listening to Sergeant Alexander Mason of the "Princess Pat" regiment of Light Infantry, who is one of the few survivors of the famous Canadian regiment that held the line at Ypres in 1915. Sergeant Mason gave a vivid account of his experiences in the trenches and how he received the wound that finally incapacitated him.

C. E. Scott was the chairman of the committee in charge of the meeting and among the guests was A. E. Stacey, Jr., secretary of the Illinois Chapter who presented the greetings of that organization.

President Frank K. Chew announced the death of Mrs. William J. Olvany, wife of the chapter's treasurer, and the chapter's sympathies were expressed by the members rising.

At the February meeting of the chapter a paper was presented by W. L. Fleisher, who was chairman of the committee in charge, on the use of school-house heating and ventilating systems for drying and preserving fruits and vegetables, as described in THE HEATING AND VENTILATING MAGAZINE for September, 1917. Mr. Fleisher discussed the subject from a practical standpoint, making the point that school children could be employed in connection with the work. The process itself would be conducted largely in the summer months when the school plants are ordinarily idle. He illustrated his address with lantern slides furnished by the Department of Agriculture.

On motion Mr. Fleisher was invited to present his paper to the society and it was further voted to recommend that the council release the paper immediately for general distribution.

Illinois Chapter Discusses "The Kingdom of Dust."

Dust determination and its effect on the human body, based on extensive experiments conducted by the ventilation division of the Chicago Department of Health, were presented at the March meeting of the Illinois Chapter by Dr. E. Vernon Hill, president of the chapter and head of the Ventilation Division. An interesting feature of Dr. Hill's address was a series of stereopticon slides in colors.

Previous to Dr. Hill's address a report was presented of the recently-appointed standardization committee, consisting of E. F. Capron, chairman; H. M. Hart and August Kehm. The report aroused a lively discussion and the committee was tendered a vote of thanks for its efforts.

August Kehm was called on to describe the steam heating system at Camp Grant, Rockford, Ill., which was installed under his supervision. A total of 672 separate buildings are supplied with steam on a tract of land 2 by 4 miles. The experiment of carrying the steam mains overhead on poles had worked out satisfactorily at Camp Grant. Icicles frequently formed, he said, in sunny weather when the mains were covered with ice and snow, while the steam pressures in the mains ran from 40 to 70 lbs.

A Research Bureau on Household Engineering.

For some time *Good Housekeeping Magazine*, of New York, has maintained what it has termed "Good Housekeeping Institute," where apparatus and devices advertised in its columns have been tested, both as to their construction and capabilities. Those successfully passing the institute's investigation have been designated in the advertisements with a star.

The institute has now issued a booklet describing in detail its equipment and operation, the text being accompanied by numerous illustrations of the testing laboratory, in some cases with tests under way.

Among the detailed results given are those on vacuum cleaners and water-heaters. It is stated very frankly that at present the dust-bag of vacuum cleaners seems to be the weakest point in vacuum cleaner construction (portable type). The first service test given every machine is one that records the amount of suction the machine is capable of developing. This is done according to approved engineering practice. In the next test the amount of current required to operate the machine is carefully recorded. As a further guide to the efficiency of the machine under test, current readings are taken both while the machine is in actual service and while it is at rest. In addition, the number of revolutions per minute of the fan blades are counted, again under testing and working conditions.

As a result of the institute's tests it is stated that approved vacuum cleaning machines will maintain from 10 to 12 in. of suction, and that the amount of current required for operation comes to about 150 watts, which at 10 c. per kw. hr., amounts to 1½c. per hour.

Finally that a vacuum cleaner showing 12 in. on the water tube and of satisfactory construction in other respects, will pull 44 grams of flour mixture out of 50 grams through a matting rug, the mixture being first placed underneath the rug. As a final test 50 grams of the mixture are placed on the surface of a thoroughly-cleaned velvet rug of heavy pile. In a recorded number of seconds the cleaner is passed back and forth once only over the rug and then the weight of the flour removed is accurately determined. As a result of its experiments the institute endorses 16 out of the 25 vacuum cleaners it has tested.

In the matter of water heaters the tests are conducted with equal thoroughness and it is stated that all the heaters tested have proved themselves not only efficient, but well made and durable.

No less than 43 pages of the boklet are given over to a list of devices which have been approved by the institute. These include portable vacuum cleaners; dampers, regulators, etc.; household electric fans; electric heaters; gas heaters; coal and gas ranges; refrigerators; water heaters; one humidifier (Buddington); and one ozonator (Sprague). Size 8½x11½. Pp. 64, with indexes.

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Structural Service Department of the American Institute of Architects.

A notable work is being done by The American Institute of Architects in conducting in its *Journal* what is known as a "Structural Service Department." This department is conducted under the editorship of D. Knickerbacker Boyd.

The department was inaugurated in January, 1917, and during the first year the following subjects were treated:

January: Foundational Requirements, Steel and Iron, Cement and Concrete.
February: Stone Masonry, Stone and Lime.
March: Clay Products and Fire Resistive Construction.
April: Fire Prevention and Protection.
May: Timber, Lumber and Wood.
June: Electricity.
July: Gas.
August: Construction by the Government.
September: Plumbing.
October: Heating and Ventilating.
November: Metal, Plastic and Other Products.
December: Painting, Glazing and Miscellaneous.

The monthly installments were numbered serially to correspond with the number of the month in the year. For instance, the section on heating and ventilating, appearing in the October number of the *Journal*, is No. 10. This order will be continued so that the next installment of this subject will appear in October, 1918.

In addition to this work and supplementing it, the institute publishes annually "The Structural Service Book," containing, under one cover, the previous year's series of Structural Service Department articles.

Volume No. 1, of the "Structural Service Book," is now issued and sells for $3.50, while the *Journal* of the institute may be had for $5.00 annually, or $3.50 to members of the institute. The *Journal* is published at The Octagon, Washington, D. C., and either the *Journal* or the "Structural Service Book" may be obtained through the book department of THE HEATING AND VENTILATING MAGAZINE.

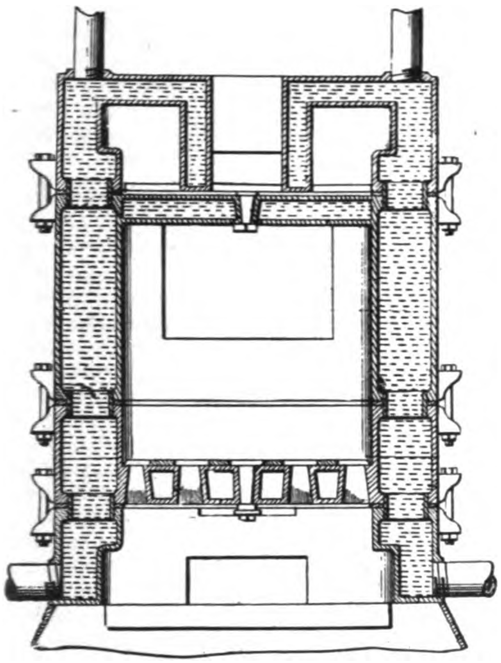
NEW DEVICES

New Type of Smokeless Boiler.

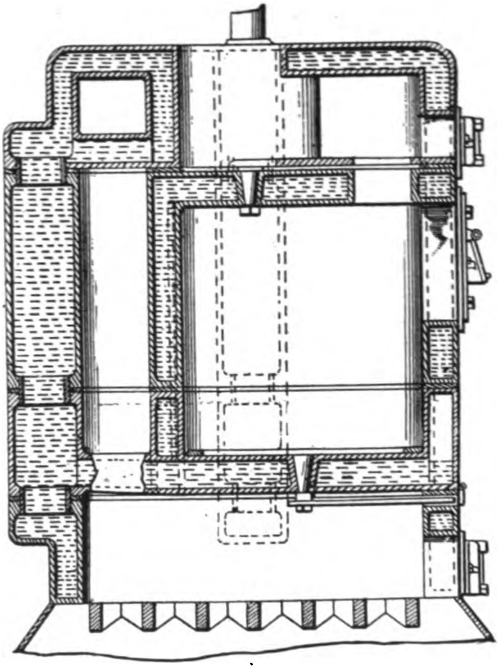
A new type of smokeless boiler for burning bituminous coal is being placed on the market by the Universal Smokeless Boiler Co., 411 Equitable Building, St. Louis, Mo. This heater is the invention of Edward H. Chenot, who is the secretary of the company. The boiler itself is of the upright, round type, of cast-iron, and contains a water-grate whereby a maximum amount of heat can be absorbed. It also contains a regulating shaker positioned on the water grate for obtaining a free flow of the products of combustion. It has three passageways for the circulation of the water. The boiler is made in three sizes for hot water, or steam.

In describing the principles involved in the design of his boiler Mr. Chenot states:

"The most important condition that make mechanical stokers successful in burning smoky coal without smoke is slow and uniform heating of the coal, with the result that a large part of the volatile matter is distilled at low temperature, and the distillation of the volatile



VERTICAL SECTIONAL VIEW OF UNIVERSAL DOWN-DRAFT BOILER, LEFT TO RIGHT, ILLUSTRATING REGULATING SHAKER POSITIONED ON WATER GATE.



VERTICAL SECTIONAL VIEW, FRONT TO BACK, ILLUSTRATING A SECTION OF THE WATER GRATE.

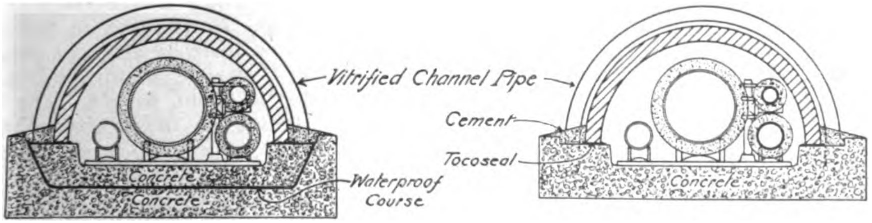
matter occurs in the presence of oxygen."

This principle is applied in the arrangement of the Universal smokeless boiler, together with principle that a long, narrow combustion space is more efficient in burning the gases than a short, wide one having the same cubical space. In the long, narrow space, the gases travel with a higher velocity which promotes mixing and therefore quickens combustion.

New Types of Steam Pipe Conduits.

A steam pipe conduit which, it is stated, combines the features of water-tightness, efficiency and durability, has been brought out by P. N. Kenway, 248 Boylston street, Boston, under the name of the W. E. D. steam pipe conduits. Among the advantages claimed for this conduit are that the pipe supports rest on a flat surface while the concrete lower portion forms a solid base on which to install the pipes; the longitudinal joint does not depend for tightness on the matching of the upper and lower sections of a split-tile pipe; all joints below the center are eliminated; the conduit can be broken into and repaired at a minimum of expense; any one of the pipes can be removed and replaced without disturbing the others; and the cost is reasonable.

As will be noted from the illustrations, the lower portion of the No. 1 conduit is



No. 1. No. 2.

THE W. E. D. STEAM PIPE CONDUIT.

composed of an outer trough-shaped monolithic shell of concrete, a water-proofing course of Tocoseal and an inner monolithic shell of concrete. The upper portion consists of vitrified channel pipe with cemented bell-and-spigot joints. Tocoseal and cement are used for sealing the longitudinal joints.

No. 2 conduit is for use only in gravelly soil where drainage conditions are exceptionally good.

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New Publications.

Percentage of Extraction of Bituminous Coal, with Special Reference to Illinois Conditions, is the title of a recent bulletin (No. 100) issued by the Engineering Experiment Station of the University of Illinois. The percentage of total available coal recovered in the process of mining is a factor of increasing importance under the present conditions when the demand for fuel is so abnormally high. Under the belief that the percentage of extraction at present is too low, especially in the mining of bituminous coal, the Engineering Experiment Station of the University of Illinois, in cooperation with the Illinois State Geological Survey and the U. S. Bureau of Mines, has undertaken an investigation of the subject and has made a somewhat elaborate study of the facts and information compiled. The work has been done under the immediate direction of Professor C. M. Young of the Department of Mining Engineering at Urbana and the results are published as Bulletin 100 of the Engineering Experiment Station.

The facts developed show that mining methods in many districts of West Virginia and Pennsylvania are yielding, under comparable conditions, a much higher percentage of extraction than those employed in the Illinois, Indiana and Western Kentucky field. It is shown also that there is an excellent opportunity to improve conditions in the Middle West field by more systematic methods of mining.

Transactions of The American Society of Heating and Ventilating Engineers for 1917, covering the proceedings of the twenty-third annual meeting in New York, in January, and those of the summer meeting in Chicago in July, have been published, making a volume of 692 pages. In addition to the numerous papers and discussions that were features of these two meetings, the volume contains full reports of the business transacted, with lists of those in attendance, officers and committees, etc. The number of papers on drying and dehydration are an interesting commentary on the growing importance of this field to the heating engineer.

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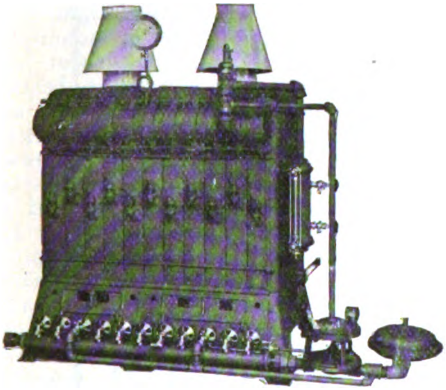
Trade Literature.

Electrically-Heated Japanning Ovens, by C. F. Hirshfield, reprinted from the N. E. L. A. Bulletin, and "Heat Calculation for Baking and Drying Ovens," by W. S. Scott, reprinted from the *Electric Journal*, are the titles of two articles of interest to those engaged in the heating of baking, drying and japanning ovens which have been reprinted, under one cover, by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. The first article gives general considerations in favor of electrical heating for this purpose, while the second article gives a detailed method of calculation for the amount of heat required to raise the temperature of the work of the supporting and carrying parts, such as trucks, and of the ventilating air. How to compute the losses from the external surface of the oven, and the heat required to raise the temperature of the oven walls, etc., are also given. The publication is listed as Reprint 66.

Ideal Specialties, including the Norwall siphon air valves, sylphon packless radiator valves, Arco temperature regulators and Sylphon water regulators, are the subject of recent circulars sent out by the American Radiator Co., Chicago, Ill. The Norwall siphon valve is shown in sectional views open and closed, illustrating how this valve relieves the radiator of air and prevents cold loops of steam radiators. Arco temperature regulators include three types of thermostats and three types of motors for regulating the draft of the heater. With this arrangement one-day or eight-day clock regulation may be secured, or regulation where clock control is unnecessary. In addition to the spring type of motor, there is also one equipped with a small electric motor and a third operated by a 10-lb. weight. The latter requires winding up more often than the spring motor. The Sylphon packless radiator valve it is stated, maintains the remarkable claims made for it that it is the only valve made which has no rotating or sliding parts exposed to the steam or water, and therefore that it cannot leak.

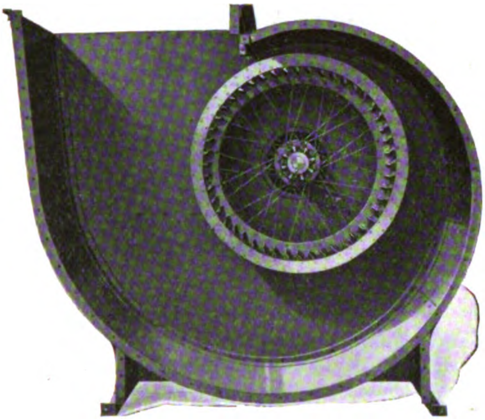
Ideal Sylphon water regulators are adapted for controlling hot water temperature in either water boilers or tanks. The circular on this device explains how this regulator is installed and operated and the statement is added that they are easily put on old outfits.

Bryant Water and Steam Heating Specialties, heated by gas, are an interesting product of the Bryant Heater & Mfg. Co., Cleveland, O., illustrated and described in a recently-issued catalogue. One of the most notable features of these heaters is the arrangement of the fire travel. The space between the sections is staggered, forcing the heat to travel a distance of 4 ft. from the burner to the flue, during the whole space of which the heat is playing against the water passages. Baffle plates along the sides of the heater are designed to prevent the gases at these points from going direct to the flue and causing them to come in contact with the heating elements the length of their travel. A baffle plate is also placed in the top of the boiler to make the draft uniform and perfectly distribute the heat over the whole interior of the combustion chamber, regardless of the number of burners in use. The sections of the boiler are of cast-iron as are the burners. The burners which are centrally supplied, have drilled holes raised above the surface of the burner, with two holes drilled in each to carry the flame to the other burners. A full series of sizes is furnished for both steam or hot water. The company also makes a number of specialties, such as steam-coil thermostats, quick-acting gas cut-off valves and temperature regulators all of which are discussed in the catalogue. Size 4¾x7½ in. Pp. 64.



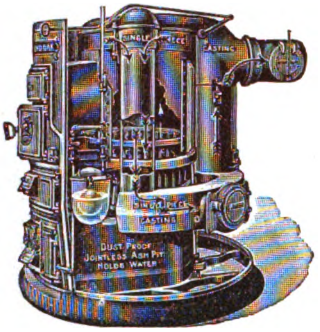
BRYANT GAS HEATER

Bayley Plexiform Fans, pulley, engine, motor and turbine driven, are treated in a noteworthy catalogue, just issued by the Bayley Mfg. Co., Milwaukee, Wis. The Plexiform fan, which is of original design, is constructed especially to meet the present-day requirements of a centrifugal-discharge fan, viz: maximum air delivery against low or medium high resistance from a minimum of housing; highest obtainable mechanical efficiency, strength, lightness, quietness in operation, and a method of construction equally adaptable to high as to low pressures and as practicable for double-width as for single-width fans. The catalogue illustrates in detail how the Plexiform fan meets these requirements. The balance of the catalogue is given up to a well-arranged compilation of engineering data, which, for the most part, can be used in connection with any fan or ventilation problem. The fan tables themselves take up no less than 64 pages. The catalogue concludes with some typical layouts, together with 32 illustrations of different arrangements of overhung pulley and overhung wheel fans. Size 7¾ x 10½ in. Pp. 104.



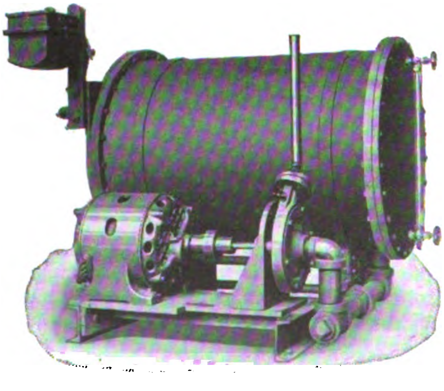
PLEXIFORM FAN WITH ONE SIDE OF HOUSING REMOVED TO SHOW INTERIOR.

Round Oak Moistair Heating System is the description given to the warm-air furnaces, with humidifiers attached, manufactured by the Beckwith Co., Dowagiac, Mich. It is evident this company has recognized the demand for an adequate humidifying system for use with warm-air furnaces and the construction of the heater shows that a serious effort has been made to meet this demand. Although the water pan is not placed above the dome of the heater, it is located next to the fire-pot and is of considerably larger size than the usual water pan. Moreover, it is kept filled automatically. The company's catalogue is handsomely gotten up, with "X-ray" views of the heater itself, together with numerous views of the various parts, supplemented by views of typical installations. The company announces that it has recently filled an order for 192 Round Oak Moistair heating systems for the homes of employees of the American Sheet and Tin Plate Company, being erected at Gary, Ind. Size 9x12 in. Pp. 26.

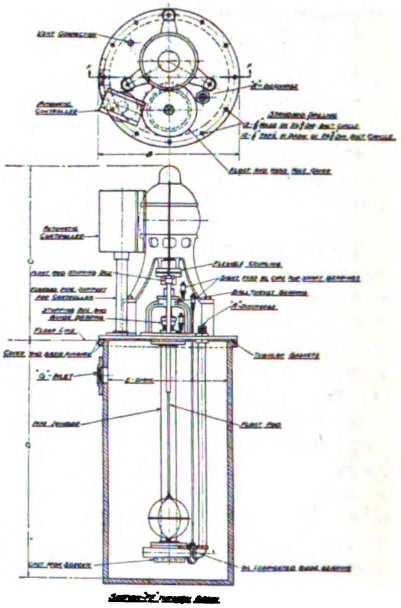


ROUND OAK MOISTAIR HEATER, SHOWING LARGE SIZE OF WATER PAN.

Yeomans Electrically-Driven Condensation Return Pumps for automatically returning condensation to boilers in low-pressure steam heating systems, are brought to the attention of the trade in Bulletin No. C-5000, issued by Yeomans Bros. Co., Chicago. These pumps are furnished in two types. Type H, for installation above a point where flood water would be likely to submerge it, and Type V for installation below the floor line. Type H consists of a heavy cast-iron receiver, horizontal centrifugal pump and continuous-duty electric motor, with adjustable, float-operated, automatic starter of the carbon butt-contact type. Type V is of the well-known Yeomans bilge type, and consists of a heavy cast-iron basin or receiver ordinarily set in an excavation with the top even with the floor line and to which is attached a steam-tight cast-iron cover. On this cover is mounted a continuous-duty vertical-type motor and yoke type dust-proof ball-thrust bearing from which is suspended by hanger and discharge pipes, a vertical, submerged-type centrifugal pump, with oil-immersed bearing. A float-operated automatic starter, with knife switch and fuses, mounted on the basin cover, controls the starting and stopping of the motor. Besides illustrating the two types and presenting, in tabular form, the characteristics of the various sizes, the catalogue contains typical forms for specifying Yeoman's pumps. Size 8½ x 11 in. (standard). Pp. 8 (punched for binding).



YEOMANS ELECTRICALLY-DRIVEN CONDENSATION RETURN PUMP.



CONSTRUCTION OF BILGE TYPE OF YEOMAN'S CONDENSATION RETURN PUMP.

◆

S. W. Huffman, president of the Huffman-Conklin Co., Columbus, O.; heating and plumbing engineers and contractors, died at his home in that city February 28. Mr. Huffman was 62 years old and was an old-time figure in the heating and plumbing trade. He leaves a widow and two daughters.

PROPER GAUGES AND WEIGHTS OF ROUND G. I. PIPE AND ELBOWS FOR DUCT SYSTEMS

Gauge and Weight per Square Foot		Diam. of Pipe, In.	Weight per Lineal Ft., Lbs.	Weight of Full Ell Lbs.	Gauge and Weight per Square Foot		Diam. of Pipe In.	Weight per Lineal Ft., Lbs.	Weight of Full Ell, Lbs.
28 g.	0.78 lbs.	3	0.7	0.4	20 g.	1.66 lbs.	38	18.2	139.4
"	"	4	1.1	0.9	"	"	39	18.7	146.0
"	"	5	1.2	1.2	"	"	40	19.1	152.9
"	"	6	1.4	1.7	"	"	41	19.6	160.7
"	"	7	1.7	2.3	"	"	42	20.1	168.6
"	"	8	1.9	2.9	"	"	43	20.6	176.7
26 g.	0.91 lbs.	9	2.4	4.3	"	"	44	21.0	185.0
"	"	10	2.7	5.3	"	"	45	21.5	193.4
"	"	11	2.9	6.4	"	"	46	22.0	202.2
"	"	12	3.2	7.6	18 g.	2.16 lbs.	47	29.2	274.3
"	"	13	3.4	8.9	"	"	48	29.8	286.6
"	"	14	3.7	10.4	"	"	49	30.4	298.8
25 g.	1.03 lbs.	15	4.5	13.5	"	"	50	31.0	309.9
"	"	16	4.7	15.1	"	"	51	31.6	322.5
"	"	17	5.0	17.0	"	"	52	32.2	335.1
"	"	18	5.3	19.1	"	"	53	33.0	349.7
"	"	19	5.6	21.4	"	"	54	33.6	363.4
"	"	20	6.0	23.9	"	"	55	34.4	377.2
24 g.	1.16 lbs.	21	7.0	29.6	"	"	56	34.9	390.7
"	"	22	7.3	32.3	"	"	57	35.6	405.1
"	"	23	7.7	35.6	"	"	58	36.1	418.8
"	"	24	8.0	38.6	"	"	59	36.7	433.1
"	"	25	8.3	41.7	"	"	60	37.4	448.6
"	"	26	8.7	45.1	16 g.	2.66 lbs.	61	46.7	569.7
22 g.	1.41 lbs.	27	10.9	59.1	"	"	62	47.5	589.0
"	"	28	11.4	64.2	"	"	63	48.3	608.6
"	"	29	11.8	68.6	"	"	64	49.1	628.5
"	"	30	12.2	73.4	"	"	65	49.8	647.4
"	"	31	12.6	78.3	"	"	66	50.5	666.6
"	"	32	13.0	83.4	"	"	67	51.3	687.4
"	"	33	13.5	88.9	"	"	68	52.1	708.6
"	"	34	13.9	94.3	"	"	69	52.8	728.6
"	"	35	14.3	99.9	"	"	70	53.6	750.4
20 g.	1.66 lbs.	36	17.2	124.4	"	"	71	54.3	771.0
"	"	37	17.8	131.4	"	"	72	55.1	793.4

In this table the weights include rivets, solder and due allowance for trimming and laps; the elbows have an internal radius equal to the diameter of the pipe. Rectangular pipes are usually made of same gauge as round pipes of equal area.

B. F. Sturtevant Co.

FACTORS FOR REDUCING WEIGHT OF G. I. PIPE OF ANY GIVEN GAUGE TO THAT OF ANY OTHER GAUGE.

Given Gauge	OTHER GAUGES AND WEIGHT IN POUNDS PER SQUARE FOOT																
	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
	4.53	3.91	3.28	2.97	2.66	2.41	2.16	1.90	1.66	1.53	1.41	1.28	1.16	1.03	.91	.84	.78
12	1.00	.86	.72	.66	.59	.53	.48	.42	.37	.34	.31	.28	.26	.23	.20	.19	.17
13	1.16	1.00	.84	.76	.68	.62	.55	.49	.43	.39	.36	.33	.30	.26	.23	.22	.20
14	1.38	1.19	1.00	.91	.81	.74	.66	.58	.51	.47	.43	.39	.35	.32	.28	.26	.24
15	1.53	1.32	1.10	1.00	.90	.81	.73	.64	.56	.52	.48	.43	.39	.35	.31	.28	.27
16	1.70	1.47	1.23	1.11	1.00	.91	.81	.71	.62	.58	.53	.48	.44	.39	.34	.32	.29
17	1.88	1.62	1.36	1.23	1.10	1.00	.90	.79	.69	.63	.59	.53	.48	.43	.38	.35	.32
18	2.10	1.81	1.52	1.38	1.23	1.12	1.00	.88	.77	.71	.65	.59	.54	.48	.42	.39	.36
19	2.38	2.06	1.73	1.56	1.40	1.27	1.14	1.00	.87	.81	.74	.67	.61	.54	.48	.44	.41
20	2.72	2.36	1.98	1.79	1.60	1.45	1.30	1.16	1.00	.92	.85	.77	.70	.62	.55	.51	.47
21	2.96	2.56	2.14	1.94	1.74	1.57	1.41	1.24	1.09	1.00	.92	.84	.76	.67	.59	.55	.51
22	3.21	2.77	2.32	2.10	1.89	1.71	1.53	1.35	1.18	1.08	1.00	.91	.82	.73	.65	.60	.55
23	3.54	3.07	2.56	2.32	2.08	1.88	1.69	1.49	1.30	1.20	1.10	1.00	.91	.81	.71	.66	.61
24	3.90	3.37	2.82	2.56	2.29	2.08	1.86	1.61	1.43	1.32	1.22	1.10	1.00	.89	.78	.72	.67
25	4.40	3.79	3.18	2.88	2.58	2.34	2.10	1.86	1.61	1.49	1.37	1.24	1.12	1.00	.88	.82	.76
26	4.98	4.30	3.60	3.26	2.92	2.65	2.37	2.10	1.82	1.68	1.55	1.41	1.27	1.13	1.00	.92	.86
27	5.40	4.66	3.90	3.54	3.17	2.87	2.57	2.28	1.96	1.82	1.68	1.52	1.38	1.23	1.08	1.00	.93
28	5.81	5.01	4.20	3.80	3.41	3.09	2.77	2.45	2.13	1.96	1.81	1.64	1.49	1.32	1.17	1.08	1.00

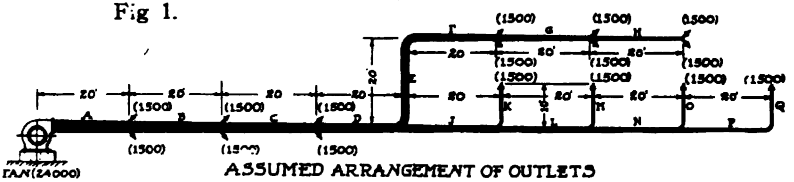
Example: To find weight of 28-in. pipe of No. 16 gauge. On data sheet No. 10-K, 28-in. pipe of No. 22 gauge weighs 11.4 lbs. Picking out the No. 22 gauge line in the above table and following across to the column marked "16 g." we find the correction factor 1.89 and 11.4x1.89=21.55 lbs., if made of No. 16 gauge metal.

B. F. Sturtevant Co.

DUCTS AND FLUES—FACTORS TO CHANGE GAUGE. No. 10-L.

SIZING OF DUCTS AND FLUES
METHOD NO. 1.

Fig 1.



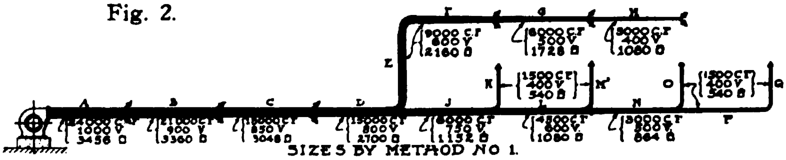
ASSUMED ARRANGEMENT OF OUTLETS

Fig. 1 involves supplying 1,500 cu. ft. of air to each of sixteen outlets, located as shown, from a fan placed at the left-hand end. It is assumed that these outlets are in different rooms but that air requirements are the same or, if the air is used for heating, that the heat requirements are identical.

Assume velocities in the ducts ranging from 1,000 ft. per minute at the fan down to 500 ft. per minute in mains P and H. Size the ducts on the basis of the area required to pass the given quantity of air at the given velocity. Size flues on the basis of 400 ft. per minute velocity; size the registers on the basis of 250 ft. per minute velocity through the free area.

This gives a schedule of sizes as shown in the following table:

Fig. 2.



SIZES BY METHOD NO 1.

SOLUTION OF PROBLEM SHOWN IN FIG. 1, ACCORDING TO METHOD USED BY WRITER.

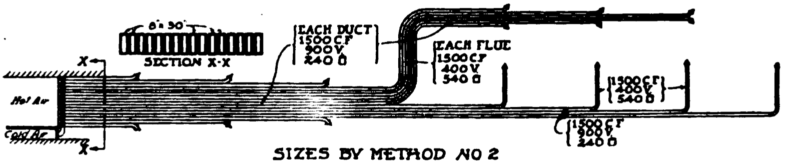
Duct or Flue	Length	Cubic Feet per Min.	Velocity Ft. Per. Min.	Area Sq. In.
A	Immaterial	24,000	1,000	3456
B	"	21,000	900	3360
C	"	18,000	850	3048
D	"	15,000	800	2700
E	"	9,000	600	2160
F	"	9,000	600	2160
G	"	6,000	500	1728
H	"	3,000	400	1080
J	"	6,000	750	1152
K	"	1,500	400	540
L	"	4,500	600	1080
M	"	1,500	400	540
N	"	3,000	500	864
O	"	1,500	400	540
P	"	1,500	400	540
Q	"	1,500	400	540

Registers equal 1500/250, or 6 sq. ft. net. This method is short, simple and in practice gives good results, the areas being as shown in Fig. 2.

SIZING DUCTS AND FLUES

METHOD NO. 2.

NOTE—In THE HEATING AND VENTILATING MAGAZINE for October, 1916, in an article by Harold L. Alt, various methods of sizing ducts and flues were outlined and examples shown. These comprise in all six different schemes of which one of each is illustrated and briefly outlined in Standard Data Sheets Nos. 10-M, 10-N, 10-O, 10-P, 10-Q, 10-R and 10-S. The example assumed for comparison is shown in Data Sheet No. 10-M (Fig. 1) and the reader is referred to the article in question for a more complete discussion of the subject.



SIZES BY METHOD NO 2

Another method is not to use a trunk line at all unless all the outlets are in the same room. Where different rooms are supplied with air, different temperature requirements are encountered and this is taken care of by an individual duct system. In this system a single, separate duct is carried to each room (in this case, each outlet) and the air is supplied at the warmer or cooler temperature required. Automatic control operates mixing dampers in the hot and cold air chambers so as to give the desired temperature.

This method is illustrated diagrammatically herewith, the velocity in the flues being 400 ft. per minute and in the ducts being 850 to 900 ft. per minute; the ducts are made 8 in. wide by the depth required to give this velocity.

1500/850=1.76 sq. ft. x 144 = 253.44 sq. in. and this divided by 8 = 31+in. depth, 30 in. is usually adopted.

Velocity through registers, 300 ft. per minute through free area. This gives a schedule of ducts and flues as shown in the following table:

DUCT AND FLUE SIZES AS FIGURED BY METHOD NO. 2.

Ducts and Fues.	Length.	Cu. Ft. Per Min.	Velocity Ft. Per Min.	Area Sq. In.
All Ducts	Immaterial	1500	900	240
All Flues	Immaterial	1500	400	540

Registers 1500/300=5 sq. ft. net.

A Message from the Tuscania

Fathoms deep in their final resting place off the Irish Coast the hearts of brave Americans —your brothers and mine—cry out to every red-blooded man in the United States, Do Your Bit Now To SPEED UP THE WAR.

The fact that this was murder—not warfare—serves only to make us pull our belts tighter and resolve still more earnestly to help in whatever way we can—with money, brain, hand and heart—to make this recurrence of world frightfulness impossible forever. Every one of us must help to stamp out effectually the Prussian idea of military domination of the world. See to it that the civilian slacker is as much out of place today as the military slacker.

SPEED UP THE WAR YOURSELF. Apply at once for any one of the positions listed below which you are competent to fill. Remember that this is not only a much needed and highly patriotic service, but that it is also an unusual opportunity to come in contact with new and greater possibilities for advancement—not only during the period of war, but in the busy days of peace that will follow.

GET BUSY TODAY

DON'T HESITATE BECAUSE YOU ARE NOT AN EXPERT

High school education, some shop training and natural ability to adapt yourself to new work may be sufficient to secure a Government appointment in which, under competent instructors, you will receive special training and be qualified for advancement in a few weeks. If you are technically equipped so much the better—apply at once, and help Speed Up the War.

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Inspectors, Gun Carriages and Parts

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Assistant Inspectors, Motor Vehicles and Artillery Wheels

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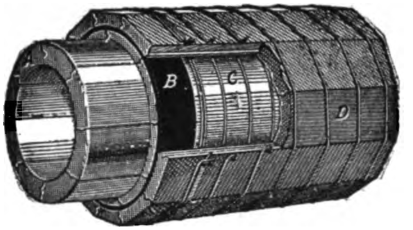
Accustomed to work to 1,000's of an inch

Send your own application and urge your friends and associates who may be competent in any of the lines indicated. You will not be required to report for examination at any place, but will be rated in accord with your education, preliminary and general experience in the specific lines indicated. Applications will not be accepted from persons already in Government service unless accompanied by written assent from the head of the office, firm or corporation by whom applicant is employed. Papers will be rated promptly and certification made as rapidly as possible.

All necessary information on application by letter to

C. V. MESEROLE
Special Representative, Ordnance Department, U. S. A.
Room 800, 79 Wall Street, New York City



A—Inner Shell, 2 inches thick.
B—Asphaltum Packing.
C—Dead Air Space.
D—Outer Shell, 1 inch thick.

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THE HEATING AND VENTILATING MAGAZINE

Cooperstown, N. Y. MAY, 1918 1123 Broadway, New York

Modern Practice in Vapor Heating

Approved Methods and Devices for Installing and Operating this Type of System.

I.

By HAROLD L. ALT.

The subject of heating has so much variety, so many points of interest, and involves so much detail that few heating men are thorough masters of the craft. This is not said with any desire to reflect upon the average designer, but on the contrary it is an entirely natural result, since a busy man seldom has the time to devote to any subject, however important it may be, the amount of attention he would like to give. In the olden days a plain system of gravity steam heating served almost every purpose and there was little cause for the refinement, economy and flexibility which is demanded at the present time; nowadays so many varieties of steam heating are in existence, both patented and unpatented, that it is hard even to completely list them.

Hot-water heating may be counted as partly responsible for this, since it is the hot-water system which has forcibly brought to notice the desirability of varying the amount of heat obtained from a radiator and the improved results attained where the heat is regulated to meet the requirements of the outside temperature rather than being either all on, or all off, as was naturally the case with the common gravity steam system.

It is generally acknowledged that vapor or vacuum-vapor heating possesses certain merits, in fact, almost all of the merits which can be urged for hot-water, and at the same time does not possess the objections which are often cited as detrimental to hot-water systems. This method of steam heating also compares favorably both in economy and cost of installation with hot-water. It responds quickly to increased or decreased draft, i. e., (it is easy to control) and possesses no large body of water which must be cooled or warmed *in toto* before a variation in the quantity of heat is obtained. During unseasonable warm days this system can be shut down and the radiators carried absolutely cold until such time as the outside temperature requirements may necessitate a re-opening of the drafts, and it absolutely avoids the danger of leaks from automatic air valves, which is an item of considerable importance.

DIFFERENT DESIGNATIONS OF SYSTEM, BUT SAME PRINCIPLE

This system is variously known as the "vapor," "vapor-vacuum," "modulated" "atmospheric" or "thermograde" system. While a vacuum may be obtained at times it is not essentially a vacuum system, owing to the fact that a positive pressure is usually carried on the boiler. In spite of this the return line never rises in pressure above the surrounding atmosphere, due to the fact that the return line itself is actually open to the atmosphere and, therefore, it cannot have any pressure generated therein. This naturally leads to the heart of the matter by suggesting the query, "How can there be a pressure in the boiler without a pressure on the return line?"

This is caused by the head of water which is maintained in the return. For instance, if there is a steam pressure of 1 lb. per square inch of steam in the boiler there is a pressure of 1 lb. per square inch tending to force the water out through the return and back into the system. This is what actually happens so that in order to arrange a system to carry 3 lbs. steam pressure the lowest part of the return where the air vent is taken off and also the lowest radiation must be not less than a good 7 ft. 6 in. above the normal water-line to allow for producing the required head when the allowable steam pressure is generated. Then, when 3 lbs. is raised in the boiler, the return backs up until a head is produced which exerts a 3-lb. pressure above the normal water-line, thus counterbalancing the boiler pressure, this point being approximately 7 ft. above the normal water-line.

PRINCIPLES OF OPERATION

Referring to Fig. 1, the operation of this system may be followed in detail. In this figure the boiler B supplies steam to the steam main SM, this main supplying the steam risers S which may be either up-feed or down-feed, the radiators R shown being supplied by an up-feed system. The steam follows up the various risers to the graduated valves V on the radiators, these valves being the same as used on an ordinary vacuum system and having graduated control (so that certain portions of the radiator may be heated) such as ¼, ½, ¾ and full, as shown in plan and elevation, Fig. 2. The steam enters the radiator through these valves and heats the proportion of surface approximately as indicated on the dial over which the pointer is placed.

To enable the steam to enter the radiator it is necessary for it to force a certain amount of air out of the radiator, all of this air passing out through the return, there being no air valves on this system. Therefore, the return valves T are what are known as "air and water-relief" valves, as shown in Fig. 3, being identical with the return valves used for radiators on strictly vacuum systems. In fact, any sort of a trap passing both air and water may be used for this purpose.

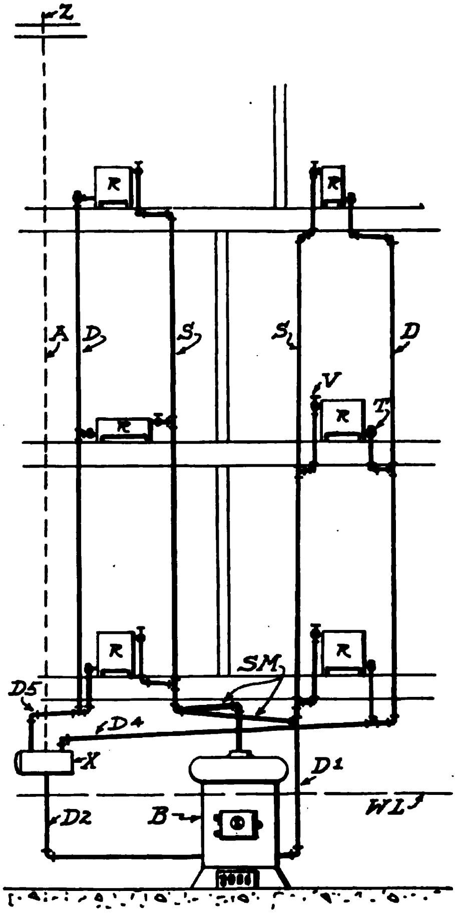


FIG. 1—DIAGRAM OF OPERATION OF VAPOR-HEATING SYSTEM.

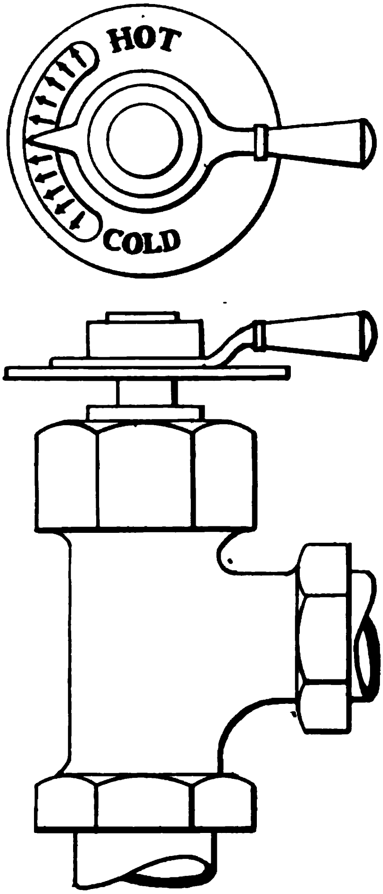


FIG. 2—TYPICAL DESIGN OF RADIATOR VALVE FOR VAPOR HEATING SYSTEM.

TYPES OF VALVES USED ON RADIATORS

These valves are of two separate and distinct types, one operated thermostatically and the other having a float mechanism. The thermostatic type is made in two forms, the older style having some material (with a high expansion coefficient) which expands when heated and closes the return valve in just the same manner as the modern automatic air valve closes when the steam strikes it.

Referring to the float or "water-seal" valve, in one type the air rises in the annular space around the float and follows down the space around the stem into the return. This path is open at all times except when the water enters the trap or rises a sufficient amount to raise the float. At this time a plate on the tube through the center of the float raises a valve against the air outlet into the top and also raises a valve off the seat in the bottom, thus permitting the water to flow out. After the water is relieved the float again assumes the lower position.

Another return valve for radiator use is of the "sylphon" type in which the common and well-known sylphon bellows displaces the expansion member used on the plain thermostatic valve.

These valves remain open, for the passage of air at least, until steam strikes them at which time they close to the steam and remain closed, allowing only the air and water to pass through into the return lines D. The air and water follow down these returns, ultimately being collected by the return mains D4 and D5 in the basement. This main is carried as high as possible since its height, together with that of the air relief pipe and the radiation, determine absolutely the pressure which can be carried on the boiler, as previously explained.

The air and water flow along this return main and into the tank X where the air relief line A leaves the top of

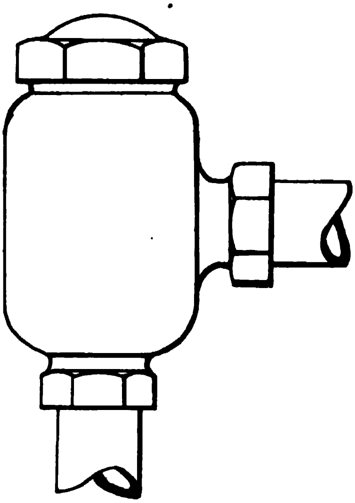


FIG. 3—TYPICAL "AIR AND WATER RELIEF" VALVE.

the return tank X, this permitting the air to escape when it is caught between the return water and the water in the vertical boiler return pipe D2. The air passes out through the vent pipe A which is carried through the roof at Z or to the atmosphere at some other convenient point. The condensation water then passes down through the boiler return pipe D2 and enters the boiler B.

Where necessary to drip steam mains or low points of steam pipes on the radiator side of the return valve, drip lines must be installed and, in order to avoid a multiplicity of return valves, these drips are all connected into a horizontal line in the basement which is drained by a drip valve which discharges the water into the drip return D4 or D5 or with the boiler return D2. Since the air finds its outlet entirely through the radiators it is not essential that the drip return be above the water line, as the flooding of this pipe does not interfere with the air relief in the system or with the returning of the drip to the boiler.

DRIP VALVES ON MAINS MUST BE OF WATER-SEAL TYPE.

Particular attention is called to the fact that a drip valve on the main cannot be used satisfactorily unless of the "water-seal" type, owing to the steam drip being so hot as to seriously affect the operation of a thermostatic trap. If it is desired to use syphon traps throughout it is necessary to connect the steam drip to the trap through a water-seal leg about 24-in. deep to prevent the high temperature water interfering with the thermostatic action.

Some firms which have made a specialty of this class of work maintain that an air-separating tank should be used to give the best results connected up in the manner shown in Fig. 1, as this avoids the danger of carrying any part of the return water up into the vent pipe as might possibly happen when only pipe connections are used. Others use simply a tee with the return coming into the branch, the air line off the top and the boiler returns out of the bottom.

ADVANTAGE OF USING WATER TYPE OF RADIATORS

A typical radiator connection is shown in Fig. 4 and it will be noted that the radiators are of the water type, with a top connection on the supply side. This is not absolutely necessary but with leg radiators it is an advantage, making the graduated valves V more accessible than if they were located at the bottom of the radiator, as is customary with ordinary gravity steam systems.

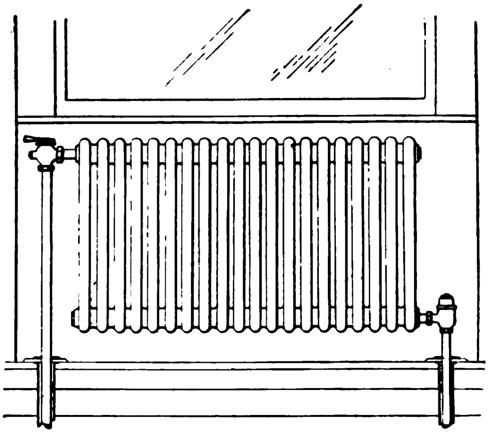


FIG. 4—TYPICAL RADIATOR CONNECTIONS FOR VAPOR HEATING.

On the other hand, with a wall radiator it would be inconvenient to have the valve at the top of the radiator owing to the difficulty of reaching same when the radiator is 5 ft. or more above the floor. For this reason the valve is located on the wall at hand height but the top connection is used to allow flexibility of connection between the radiator and the riser. It would be entirely practicable in this case to use a bottom connection when it is possible to get a swing joint or other flexible type of pipe connection between the radiator and the riser with the supply in this location.

STEAM TYPE OF RADIATOR USED WITH THERMOSTATIC CONTROL

Where thermostatic control is employed the hot-water type, of radiator with the top inlet and bottom outlet, is abandoned and the regular steam type is used. The supply and return valves are common diaphragm-operated globe valves which are controlled by *positive*-action thermostats.

TRAPPING OF DRIP LINE

It is desired to call attention again to the matter of the drip line and the trapping of same. It is not required to use a trap in this location at all provided a sufficient depth of waterseal can be obtained; that is to say, if it is expected to run this system on a maximum pressure of 1 lb., a water-seal of 2½ ft. would be ample to prevent steam blowing into the return and then out through the air vent. Owing to the liability, however, of excessive pressure being used by accident at times, it is believed to be much better to practice to employ a trap.

OPERATION OF SYSTEM ON A PARTIAL VACUUM.

Another advantage possessed by this system is its ability to be run as a partial vacuum if so desired; the only change required to make this feasible is the placing of a check-valve in the air-relief pipe so that air once blown out of the system cannot come back again upon the production of a partial vacuum within the system. This check valve should be of the type commonly known as an "impulse" check which is made largely on the same style as the ordinary check but which has the tongue suspended on an angle of approximately 60°, instead of 45°, making the operation of the check exert much less back pressure on the system than when the ordinary type is employed. Of course it is desirable to facilitate air relief in every way possible and on this account the impulse check should be given the preference over the common type.

Where this system is installed radiators set under window seats or in recesses can be controlled by carrying the extended valve spindle up through the grille either on the top or on the side—which, of course, means that in this case the valve itself must be turned on its side; these graduated valves work with equal facility either way.

For coils on the ceilings, walls, or other inaccessible places chain wheels are mounted on the graduated valves and carried down to corresponding chain wheels with indicating dials located at a convenient point on the wall.

If it should prove desirable at any time to raise the steam pressure over that originally contemplated and permitted, or if the vertical head obtainable is very small, a trap may be used which will allow a boiler pressure of 5 or 6 lbs. to be carried.

In next month's and succeeding issues the principal makes of vapor and vapor-vacuum heating systems will be discussed in detail, with a view of giving the reader a comprehensive idea of the various devices and apparatus that have been developed in this branch of the art.

CHICAGO COMMISSION ON VENTILATION

Report on Air Conditions at the Paris Garter Factory

EDITED BY HARRY M. HART.

GENERAL DESCRIPTION:

The building under consideration is a modern, five-story and basement structure of reinforced concrete construction, brick-faced, having a frontage of 113 ft., on Congress Street and 157 ft., on Racine Avenue, Chicago, Ill. It has windows on all four sides and there are no other high buildings adjoining or near it to obstruct the free circulation of air.

The ceiling heights are about 10 ft. on each floor. It is adequately heated by a direct steam system, with cast-iron radiators distributed on the outside walls under the windows, there being approximately 25 radiators on each floor. The basement is heated by means of ceiling coils. The fifth floor is also provided with ceiling coils for offsetting the heat loss through the three sawtooth skylights. There are two stairhalls leading from the basement to the top floor, one being located in the northeast corner of the building and one in the southwest corner.

The ventilation is obtained by means of the windows, each floor having an area of approximately 2100 sq. ft. of wooden sash, double hung, which is equivalent to 13% of the floor area. This is 1 sq. ft. of glass to 77 cu. ft. In addition to the window ventilation the top floor is provided with three sawtooth skylights equipped with eight 24-in. globe type ventilators and two 36-in. propeller fans direct-connected. There is also a 36 in. propellor fan in the caféteria in the basement, which is only operated during the lunch hour.

During the noon hour and at night the windows are opened wide to air the building. During the daytime windows at various points are lowered slightly from the top for ventilation purposes, except in extremely cold weather when all windows are kept closed.

The basement is occupied by the boiler and pump-room, store-room, machine shop and caféteria for the use of the employees. There are about twelve men employed on this floor.

PARIS GARTER FACTORY, CHICAGO.

First floor is occupied by the general office, stock-room and shipping-room; 9 men and 45 women are employed there.

Second floor is devoted to the manufacture of various elastic and rubberized goods. There are 9 men and 210 women employed on this floor.

The third floor is devoted entirely to the manufacture of Paris garters; 2 men and 224 women employed.

The fourth floor is used as a stock-room and for the cutting of raw material to be used in manufacture; 24 men and 5 women employed.

HOME WORK DEPARTMENT, PARIS GARTER FACTORY.

The fifth (top) floor is devoted to the manufacture of paper boxes used to contain the manufactured article, and to the printing incidental to manufacture. Thirteen men and 68 women employed.

There are no dividing partitions on any of the floors excepting in the basement and for the toilets on the upper floors. The entire building is protected against fire by an automatic sprinkler system.

The welfare work of this establishment is in charge of a trained nurse whose quarters, although very inadequate as to size and facilities, are in excellent sanitary condition.

SECOND FLOOR, PARIS GARTER FACTORY.

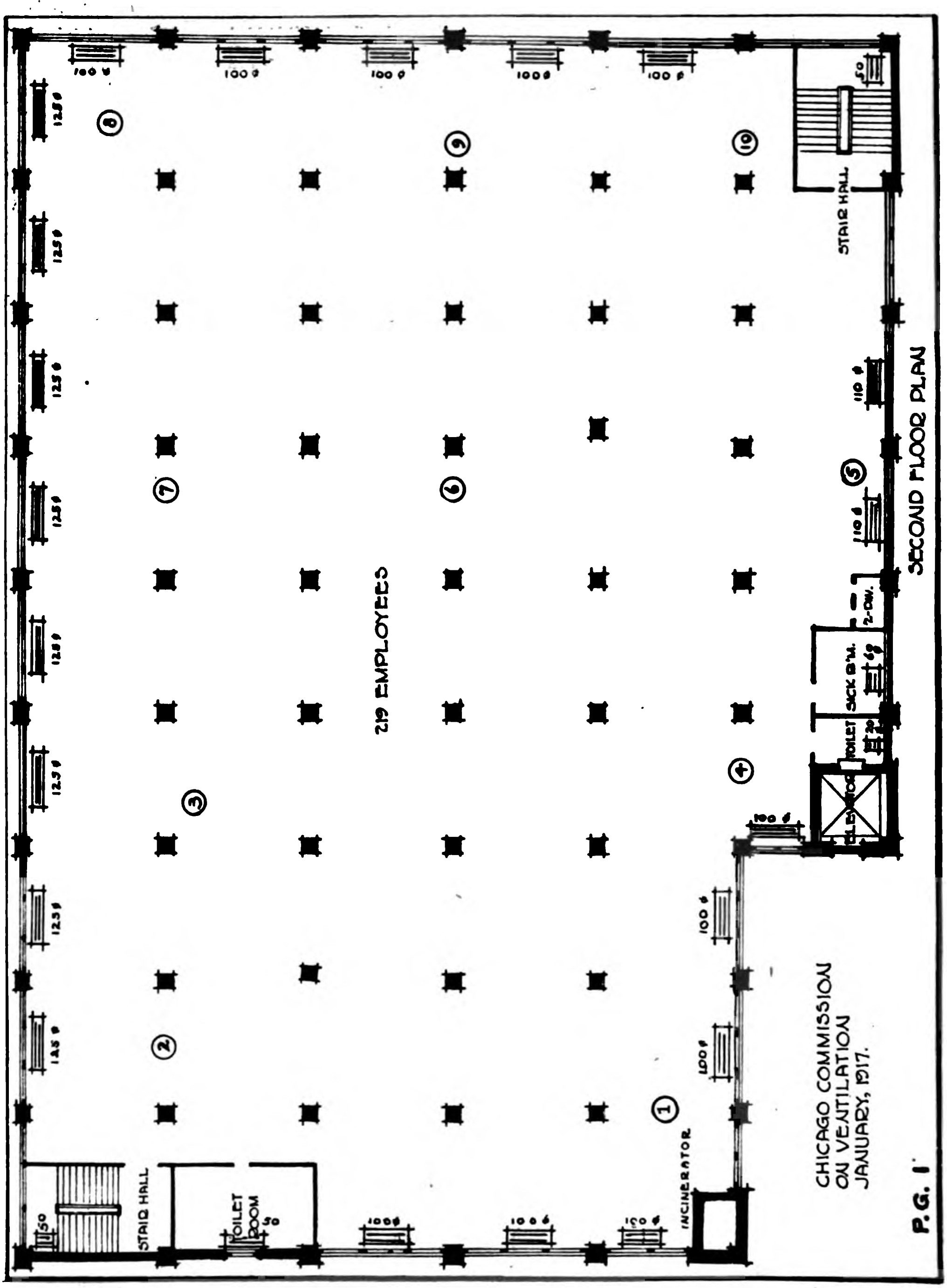
SCOPE AND METHOD OF TEST:

The tests consisted of determination of temperature, humidity, air motion, amount of dust, bacteria, odors and air supply. The temperature and humidity tests were made by use of the sling psychrometer. The number of dust particles per cubic foot of air was determined by the use of Hill's direct dust counter. The bacteria was determined by the use of two-minute exposed culture plates, in accordance with the standard method of the American Public Health Association.

Upon entering rooms the air was sensed to determine the percentage of odors. Samples of air were taken and

NORTH END OF THIRD FLOOR, LOOKING EAST.

ANOTHER VIEW ON THIRD FLOOR, PARIS GARTER FACTORY.



SECOND FLOOR PLAN, PARIS GARTER FACTORY.

analyzed for CO_2 to determine the air supply. Air motion was determined by the use of the anemometer and ammonium chloride apparatus. There were 41 psychrometer readings, 27 dust counts, 79 bacteria tests and 84 CO_2 tests taken. Stations were located on each of the floors on which tests were made that would represent the average conditions. There were ten stations on the first floor, nine on the second, and seven on the third. The locations of these stations are shown on the accompanying sketches, and the results obtained are noted on the test sheets.

A special series of tests was also made to determine the effect on the air movement caused by the exhaust fans and globe ventilators on the fifth floor, by the opening of the stairhall doors and windows.

The first series of tests were to determine the air conditions as they were found to exist during regular working hours, without any notice being taken of the position of the doors or windows, or of the operation of the exhaust fans, and these tests were confined to the second, third and fifth floors where most of the employees were at work.

The data obtained by these tests are given in the accompanying test sheets, and the results indicated by these data are best explained by referring to the synthetic air charts which are compiled from the same.

The Synthetic Air Chart was originally designed on the basis of a certain number of squares above a base line. The results of tests were plotted at the proper height above the base line and the number of squares below this subtracted from the total to arrive at the percentage of perfect. It was contended, with good reason, by some members of the Commission that the chart would be more easily read if the test data were plotted in one dimension rather than in two, as comparisons of the length of straight lines were easier than comparisons of areas.

The original chart has, therefore, been revised and the new design used in this report. The weights and relations used in the original chart have been carried out in this one without any change whatsoever, the only difference being that the test data are plotted as straight lines rather than as areas. The vertical black lines on the new chart give the results of the test in question and its relative importance as compared with other test results.

Two new scales have been added for convenience, called the "Plus and Minus Percentage." The plus percentage indicates the percentage of perfect for the test in question; the minus percentage the amount to be deducted from 100% in arriving at the total percentage for entire test. As an example, in chart No. 13, which is an average of all tests, the column under "Humidity and Air Motion" is penalized 1°. This means that the relation between temperature, humidity and air motion varies 1° from perfect, which gives a plus percentage of perfect for this factor alone of 98% and a penalization on the entire test, that is, a minus percentage of 1.8. The curves for determining the variation of the wet bulb from desirable are printed on the back of the chart.

In general it may be stated that to obtain information as to the conditions in a room, as a whole, the chart is desirable, or to compare these conditions with conditions in some other room or some other test. If the reader wishes to study local conditions in a room he is referred to the test data sheet from which the chart is compiled.*

Tests Nos. 1, 2, 3 and 4, January 11, 1917. Second Floor.

The chart for the second floor compiled from Test Sheets 1, 2, 3 and 4 gives *Temperature, Humidity and Air Motion* a penalization of 1.35%, the relative humidity being too low for the

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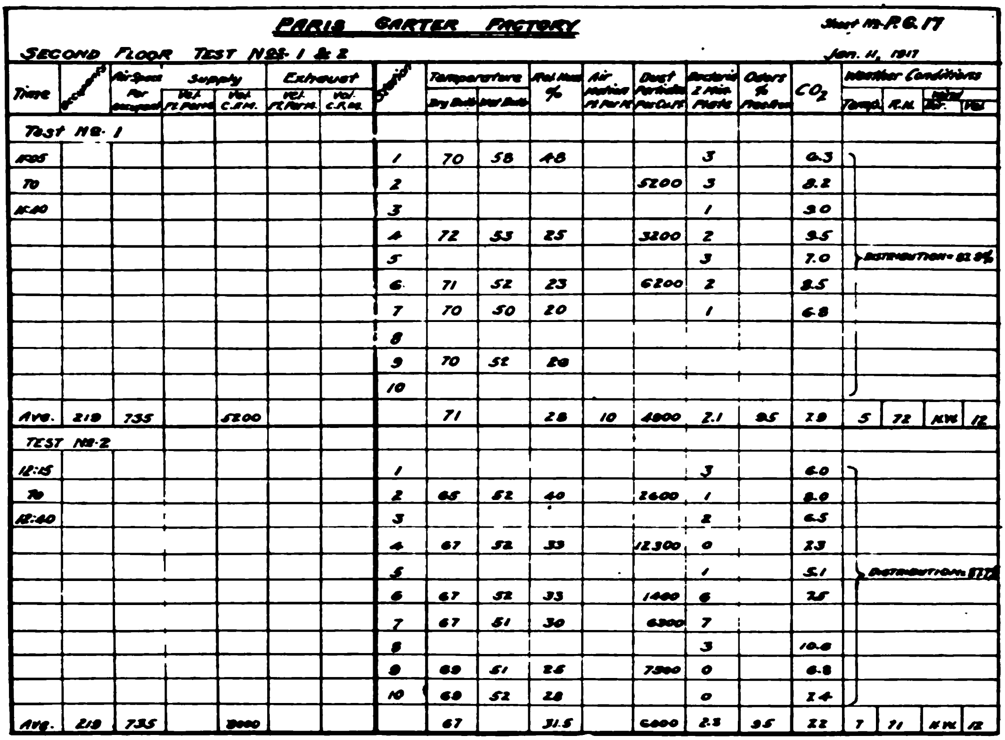
* For a complete description of the development of the Synthetic Air Chart, see the *Journal* of The American Society of Heating and Ventilating Engineers for July, 1917; also THE HEATING AND VENTILATING MAGAZINE for March, 1917.



PARIS GARTER FACTORY

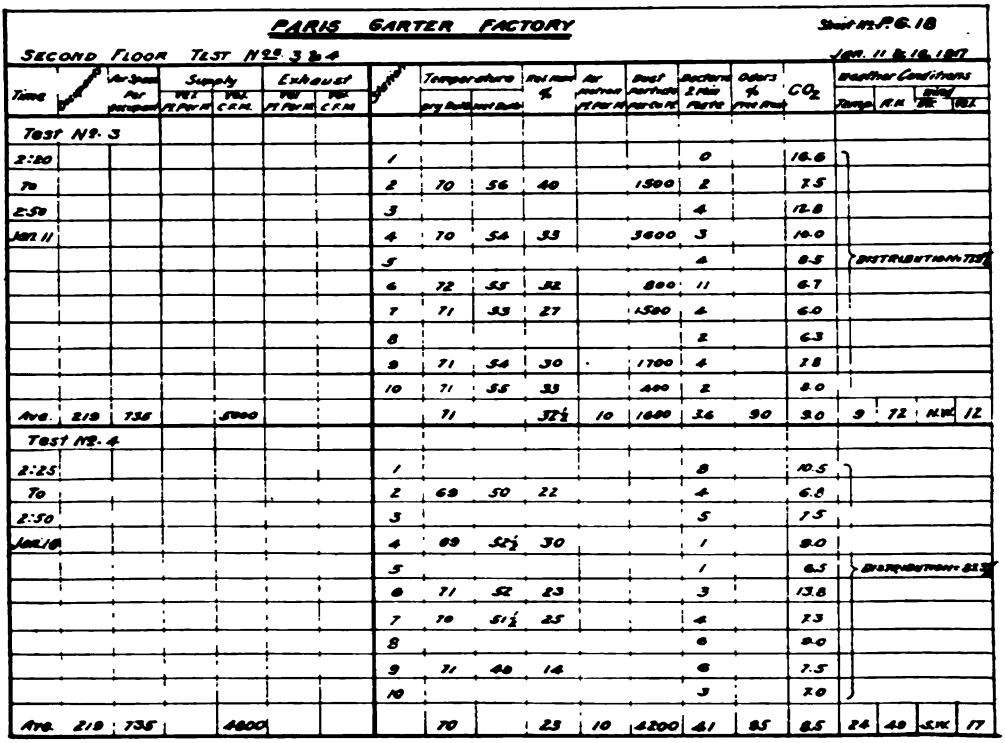
Sheet No. P.G. 17

SECOND FLOOR TEST NOS. 1 & 2

Jan. 11, 1917

Time	Occupants	Air Space Per Occupant	Supply Vel. Ft Per M	Supply Vol. C.F.M.	Exhaust Vel. Ft Per M	Exhaust Vol. C.F.M.	Station	Temperature Dry Bulb	Temperature Wet Bulb	Rel Hum %	Air Motion Ft Per M	Dust Particles Per Cu Ft	Bacteria 2 Min Plate	Odors % Free from	CO_2	Weather Conditions Temp.	R.H.	Wind Dir.	Wind Vel.
Test No. 1																			
11:05							1	70	58	48			3		6.3				
To							2					5200	3		8.2				
11:40							3						1		9.0				
							4	72	53	25		3200	2		9.5				
							5						3		7.0	DISTRIBUTION = 82.8%			
							6	71	52	23		6200	2		8.5				
							7	70	50	20			1		6.8				
							8												
							9	70	52	28									
							10												
Ave.	219	735		5200				71		28	10	4900	2.1	95	7.9	5	72	N.W.	12
TEST No. 2																			
12:15							1						3		6.0				
To							2	65	52	40		2600	1		8.0				
12:40							3						2		6.5				
							4	67	52	33		12300	0		7.3				
							5						1		5.1	DISTRIBUTION = 87.7%			
							6	67	52	33		1400	6		7.5				
							7	67	51	30		6300	7						
							8						3		10.6				
							9	69	51	26		7500	0		6.8				
							10	69	52	28			0		7.4				
Avg.	219	735		5000				67		31.5		6000	2.3	95	7.2	7	71	N.W.	12

TEST SHEET, SECOND FLOOR, TESTS 1 AND 2.



PARIS GARTER FACTORY

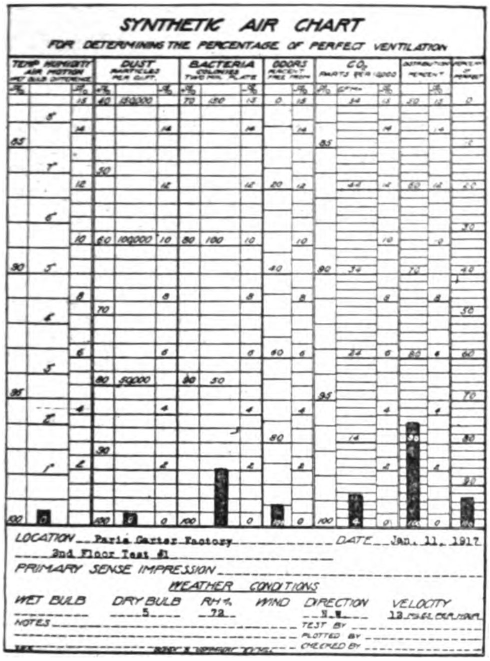
Sheet No. P.G. 18

SECOND FLOOR TEST NOS. 3 & 4

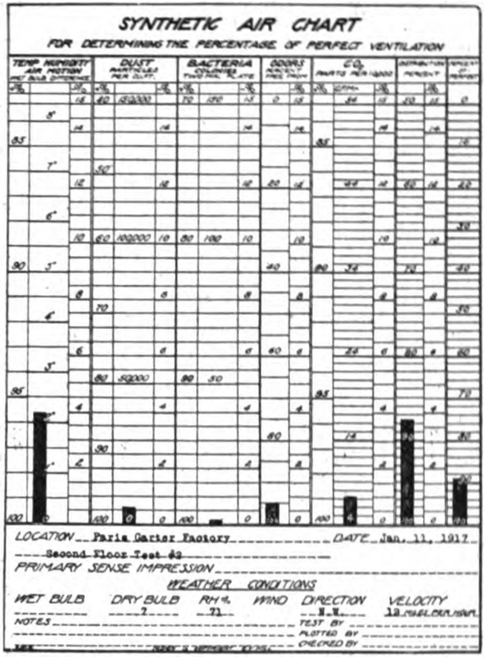
Jan. 11 & 16, 1917

Time	Occupants	Air Space Per Occupant	Supply Vel. Ft Per M	Supply Vol. C.F.M.	Exhaust Vel. Ft Per M	Exhaust Vol. C.F.M.	Station	Temperature Dry Bulb	Temperature Wet Bulb	Rel Hum %	Air Motion Ft Per M	Dust Particles Per Cu Ft	Bacteria 2 Min Plate	Odors % Free from	CO_2	Weather Conditions Temp.	R.H.	Wind Dir.	Wind Vel.
Test No. 3																			
2:20							1						0		16.6				
To							2	70	56	40		1500	2		7.5				
2:50							3						4		12.8				
Jan. 11							4	70	54	33		3600	3		10.0				
							5						4		8.5	DISTRIBUTION = 73%			
							6	72	55	32		800	11		6.7				
							7	71	53	27		1500	4		6.0				
							8						2		6.3				
							9	71	54	30		1700	4		7.8				
							10	71	55	33		400	2		8.0				
Ave.	219	735		5000				71		32½	10	1600	3.6	90	9.0	9	72	N.W.	12
Test No. 4																			
2:25							1						8		10.5				
To							2	69	50	22			4		6.8				
2:50							3						5		7.5				
Jan. 16							4	69	52½	30			1		9.0				
							5						1		6.5	DISTRIBUTION = 83%			
							6	71	52	23			3		13.8				
							7	70	51½	25			4		7.3				
							8						6		9.0				
							9	71	48	14			6		7.5				
							10						3		7.0				
Ave.	219	735		4800				70		23	10	4200	4.1	85	8.5	24	49	S.W.	17

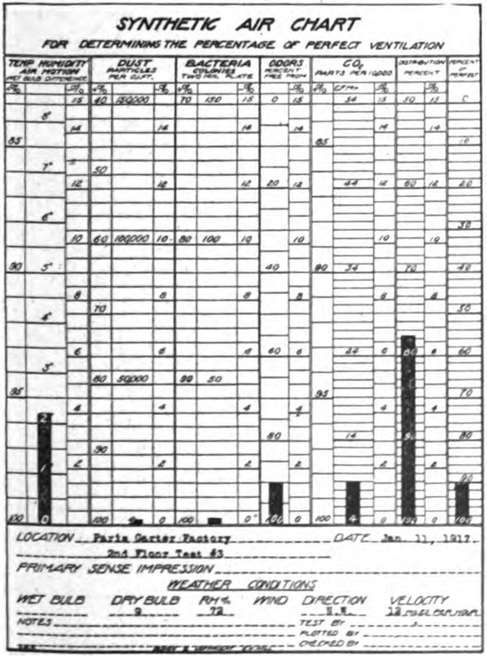
TEST SHEET, SECOND FLOOR, TESTS 3 AND 4.



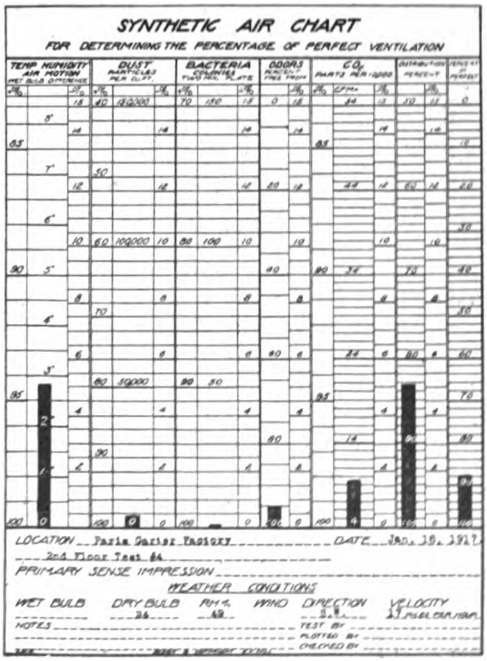
LOCATION Paris Garter Factory DATE Jan. 11, 1917
2nd Floor Test #1
PRIMARY SENSE IMPRESSION
WEATHER CONDITIONS
WET BULB
DRY BULB 5
RH% 72
WIND DIRECTION N.W.
VELOCITY 12 miles per hour
NOTES
TEST BY
PLOTTED BY
CHECKED BY



LOCATION Paris Garter Factory DATE Jan. 11, 1917
Second Floor Test #2
PRIMARY SENSE IMPRESSION
WEATHER CONDITIONS
WET BULB
DRY BULB 7
RH% 71
WIND DIRECTION N.W.
VELOCITY 12 miles per hour
NOTES
TEST BY
PLOTTED BY
CHECKED BY

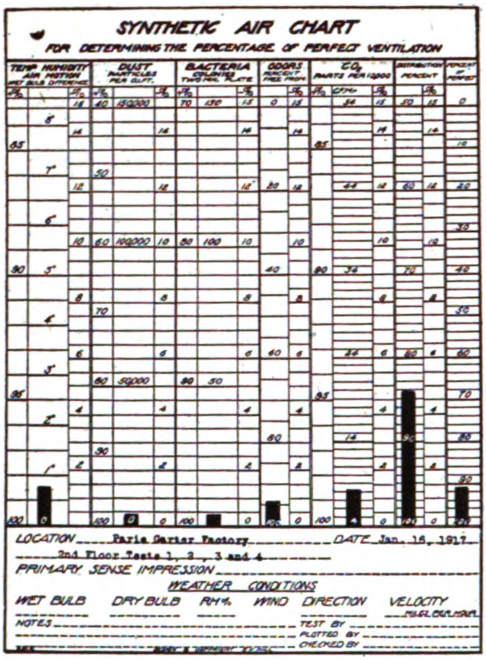


LOCATION Paris Garter Factory DATE Jan. 11, 1917
2nd Floor Test #3
PRIMARY SENSE IMPRESSION
WEATHER CONDITIONS
WET BULB
DRY BULB 9
RH% 72
WIND DIRECTION N.W.
VELOCITY 12 miles per hour
NOTES
TEST BY
PLOTTED BY
CHECKED BY



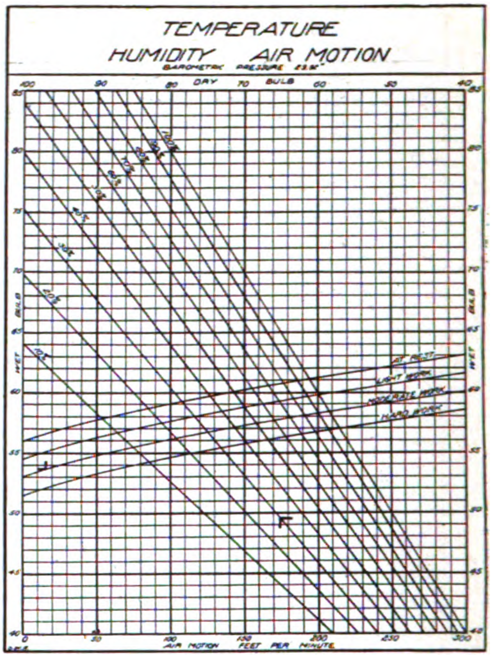
LOCATION Paris Garter Factory DATE Jan. 18, 1917
2nd Floor Test #4
PRIMARY SENSE IMPRESSION
WEATHER CONDITIONS
WET BULB
DRY BULB 24
RH% 49
WIND DIRECTION S.W.
VELOCITY 17 miles per hour
NOTES
TEST BY
PLOTTED BY
CHECKED BY

SYNTHETIC AIR CHARTS FOR SECOND FLOOR TESTS, NOS. 1, 2, 3 AND 4.



LOCATION Paris Garter Factory DATE Jan. 16, 1917
2nd Floor Tests 1, 2, 3 and 4
PRIMARY SENSE IMPRESSION
NOTES
TEST BY
PLOTTED BY
CHECKED BY

AVERAGE OF SECOND FLOOR TESTS.



REVERSE SIDE OF SYNTHETIC AIR CHART.

corresponding temperature and air movement. This condition could easily be improved by some means of artificial humidification.

The *Dust* tests give a penalization of 0.42%, or, in other words, the air is nearly free from dust. Inasmuch as fresh air is taken into the building directly from out-of-doors through the windows, this factor must necessarily be dependent on the outside air conditions as evidenced by the wide difference in samples taken on different days and to the products and methods of manufacture. Dust counts were taken with Hill's direct dust counter.

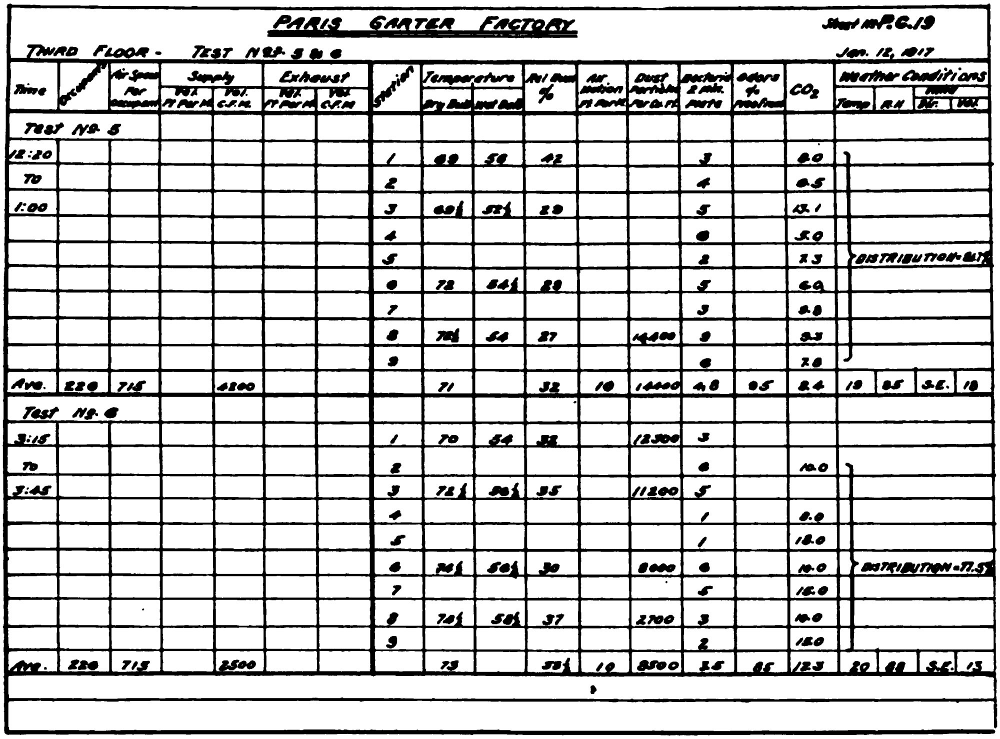
Bacteria is given a penalization of 0.4%, the average being three cultures on a standard two-minute Petrie dish. Not much improvement in this item could be expected.

Odors are somewhat of questionable importance, the ratings depending a great deal upon the inspector. The inspector giving these ratings always made it a point to note the presence of odors when just entering the room from out-of-doors. Inasmuch as he has given this floor a rating of 94% on this item, it seems reasonable to assume that very little odor of any kind was present and penalization is 0.9%.

Air Supply: 22 to 37 C. F. M. per person. Test No. 13, given later, will show that it would be possible to obtain as much as 44 C. F. M. per person by proper operation of the exhaust fans and opening of windows and doors.

Average CO_2 (8.2) is taken as a check on the volume of fresh air supply per occupant, as well as a means of determining the distribution of the fresh air. The penalization is 1.26%.

Distribution is given a rating of 84.2% on account of the wide difference in the air samples taken at various stations. This causes a penalization of 4.74%. It will also be noted that the different samples taken at the same stations on different days varied greatly, indicating that the windows were not always open at the same point even with the wind in the same direction. This only emphasizes the importance of proper manipulation of the windows, giving preference to the locations where



PARIS GARTER FACTORY

Sheet No. P.G. 19

THIRD FLOOR - TEST NOS. 5 & 6

Jan. 12, 1917

Time	Occupants	Air Space Per Occupant	Supply Vel. Ft Per M.	Supply Vol. C.F.M.	Exhaust Vel. Ft Per M.	Exhaust Vol. C.F.M.	Station	Temperature Dry Bulb	Temperature Wet Bulb	Rel Hum %	Air Motion Ft Per M.	Dust Particles Per Cu. Ft.	Bacteria 2 Min. Plate	Odors % Free From	CO₂	Weather Conditions Temp	Weather Conditions R.H.	Wind Dir.	Wind Vel.
Test No. 5																			
12:20							1	69	56	42			3		8.0				
To							2						4		6.5				
1:00							3	69½	52½	29			5		13.1				
							4						6		5.0				
							5						2		7.3	DISTRIBUTION-81%			
							6	72	54½	29			5		6.0				
							7						3		9.8				
							8	70½	54	27		14400	9		9.3				
							9						6		7.8				
Ave.	220	715		4200				71		32	10	14400	4.8	95	8.4	19	85	S.E.	18
Test No. 6																			
3:15							1	70	54	32		12300	3						
To							2						6		10.0				
3:45							3	72½	56½	35		11200	5						
							4						1		8.0				
							5						1		18.0				
							6	74½	56½	30		8000	6		10.0	DISTRIBUTION=71.5%			
							7						5		16.0				
							8	74½	58½	37		2700	3		10.0				
							9						2		12.0				
Ave.	220	715		2500				73		35½	10	8500	3.5	85	12.3	20	68	S.E.	13

TEST SHEET, THIRD FLOOR, TESTS 5 AND 6.

the greatest number of employees were.

Taken as a whole, the room is given a penalization of 90.93% which could easily be raised to 95% by giving proper attention to air distribution and humidity.

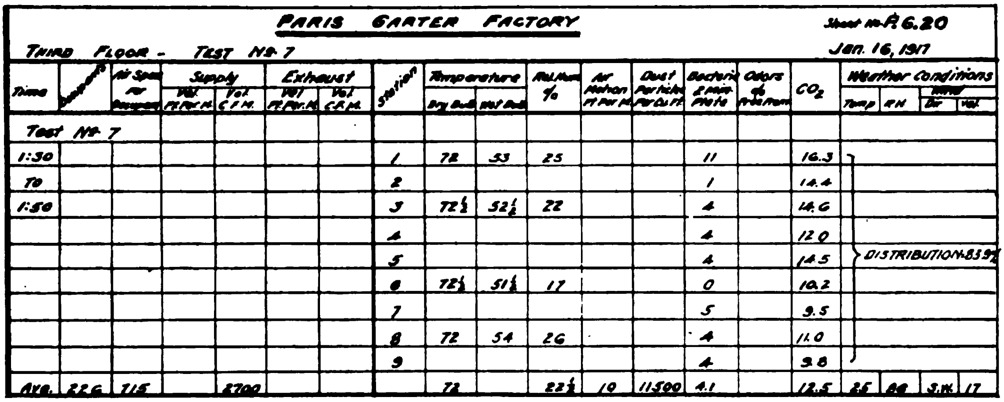
Tests Nos. 5, 6 and 7, January 12 and 17, 1917.
Third Floor.

Chart for third floor compiled from Test Sheets 5, 6 and 7 gives the following results:

Temperature, Humidity and Air Motion. Penalization is 1.36%, the relative humidity being too low in Test No. 7.

Dust: Penalization is 1.15%; not quite as good as the second floor.

Bacteria: Penalization is 0.41%; all samples were fairly good except at station No. 1, Test 7. This plate may have



PARIS GARTER FACTORY

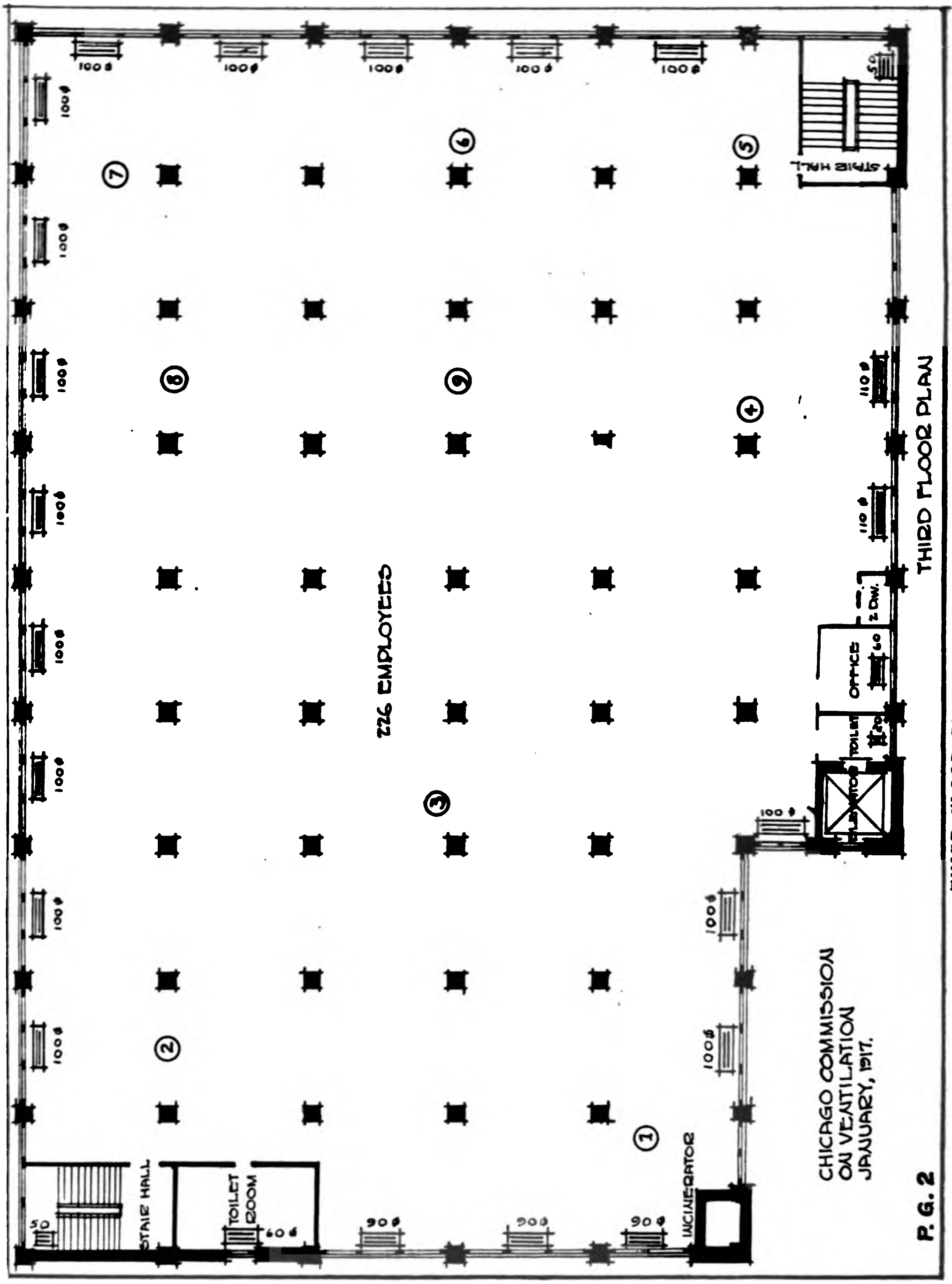
Sheet No. P.G. 20

THIRD FLOOR - TEST NO. 7

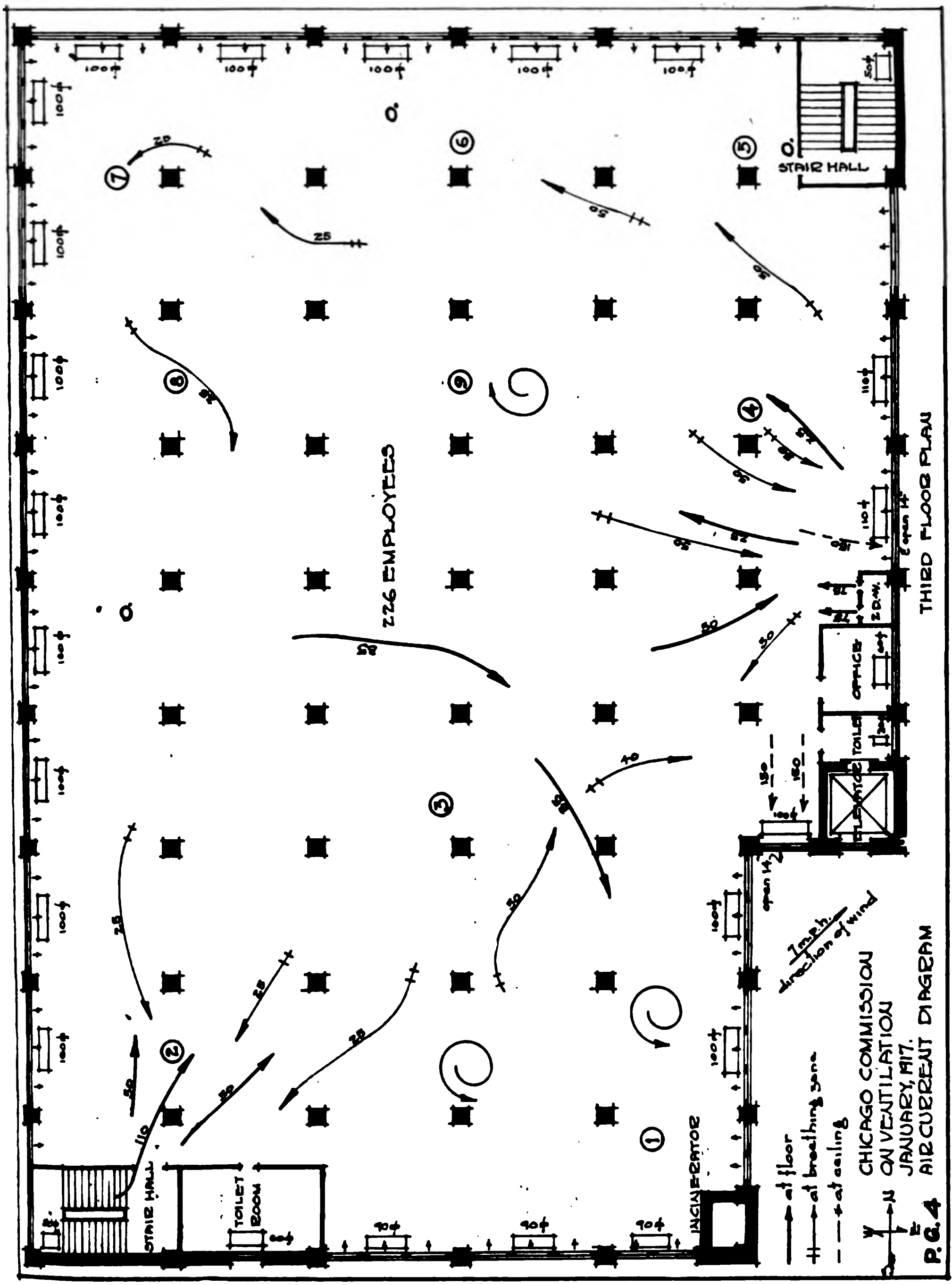
Jan. 16, 1917

Time	Occupants	Air Space Per Occupant	Supply Vel. Ft Per M.	Supply Vol. C.F.M.	Exhaust Vel. Ft Per M.	Exhaust Vol. C.F.M.	Station	Temperature Dry Bulb	Temperature Wet Bulb	Rel Hum %	Air Motion Ft Per M.	Dust Particles Per Cu. Ft.	Bacteria 2 Min. Plate	Odors % Free From	CO₂	Weather Conditions Temp	Weather Conditions R.H.	Wind Dir.	Wind Vel.
Test No. 7																			
1:30							1	72	53	25			11		16.3				
To							2						1		14.4				
1:50							3	72½	52½	22			4		14.6				
							4						4		12.0				
							5						4		14.5	DISTRIBUTION=83.9%			
							6	72½	51½	17			0		10.2				
							7						5		9.5				
							8	72	54	26			4		11.0				
							9						4		9.8				
Ave.	226	715		2700				72		22½	10	11500	4.1		12.5	25	68	S.W.	17

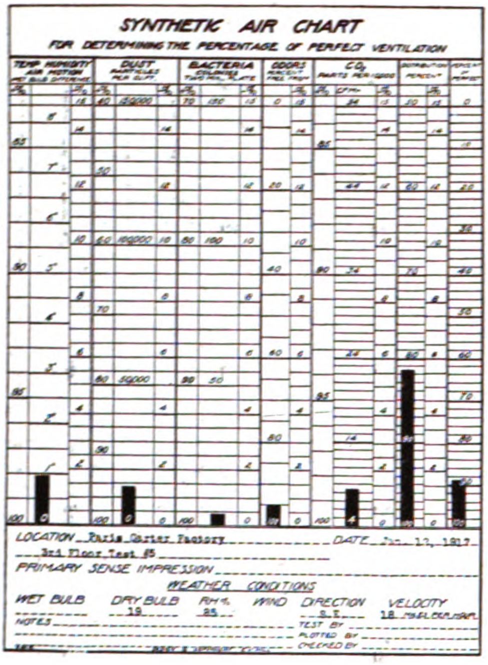
TEST SHEET, THIRD FLOOR, TEST 7.



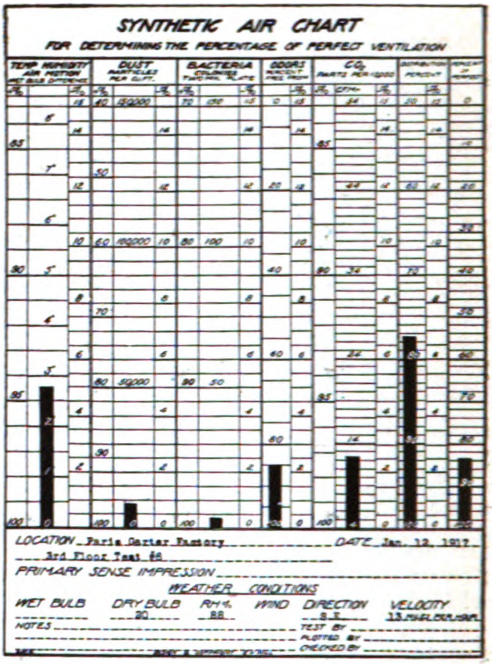
THIRD FLOOR PLAN, PARIS GARTER FACTORY.



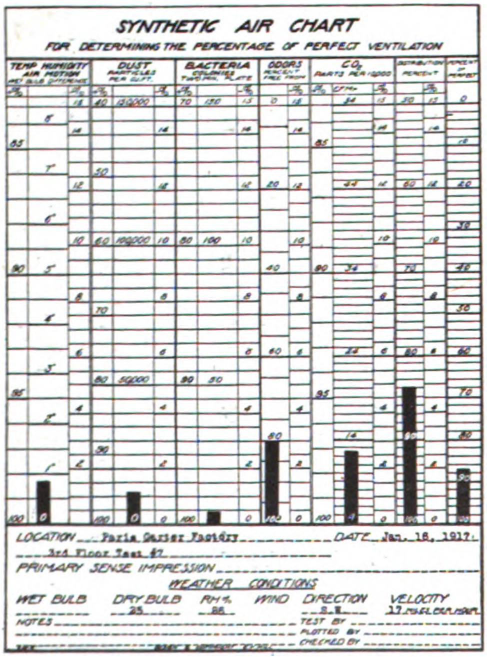
AIR CURRENT DIAGRAM, THIRD FLOOR OF PARIS GARTER FACTORY.



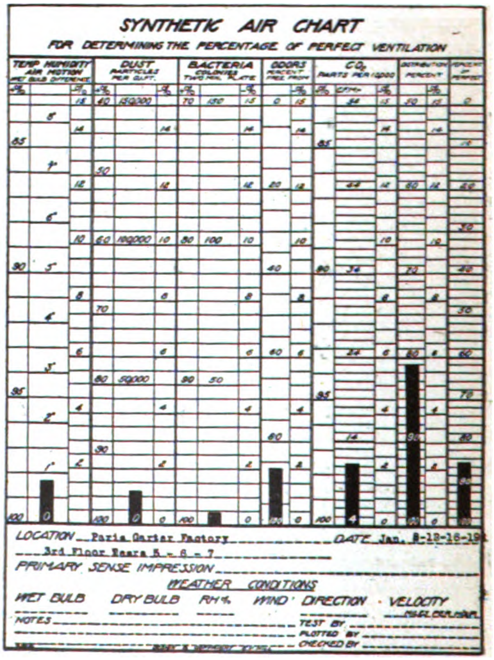
LOCATION Paris Garter Factory DATE Jan. 12, 1917
3rd Floor Test #5
PRIMARY SENSE IMPRESSION
WEATHER CONDITIONS
WET BULB DRY BULB 19 RH% 25 WIND DIRECTION S.E. VELOCITY 18 MILES PER HOUR
NOTES
TEST BY
PLOTTED BY
CHECKED BY



LOCATION Paris Garter Factory DATE Jan. 12, 1917
3rd Floor Test #6
PRIMARY SENSE IMPRESSION
WEATHER CONDITIONS
WET BULB DRY BULB 20 RH% 88 WIND DIRECTION S.E. VELOCITY 13 MILES PER HOUR
NOTES
TEST BY
PLOTTED BY
CHECKED BY



LOCATION Paris Garter Factory DATE Jan. 16, 1917.
3rd Floor Test #7
PRIMARY SENSE IMPRESSION
WEATHER CONDITIONS
WET BULB DRY BULB 25 RH% 88 WIND DIRECTION S.E. VELOCITY 17 MILES PER HOUR
NOTES
TEST BY
PLOTTED BY
CHECKED BY



LOCATION Paris Garter Factory DATE Jan. 8-12-16-19
3rd Floor Tests 5 - 6 - 7
PRIMARY SENSE IMPRESSION
WEATHER CONDITIONS
WET BULB DRY BULB RH% WIND DIRECTION VELOCITY MILES PER HOUR
NOTES
TEST BY
PLOTTED BY
CHECKED BY

SYNTHETIC AIR CHARTS FOR THIRD FLOOR TESTS, NOS. 5, 6 AND 7.

been subjected to an unusual or excessive air current during this one exposure.

Odors: Penalization is 1.95%; not as good as second floor, probably due to the lower volume of fresh air supply per occupant.

Air Supply: The maximum fresh air supply indicated 18.6 C. F. M. per person, probably due to the neutral location of this floor, which would decrease the natural air movement. This floor should be favored with opening the windows in the building. This is one of the conditions which is not so apt to be met where a mechanical air supply system is installed.

Average CO_2 (11.1) is, as hereinbefore stated, entirely due to the volume of fresh air supplied per occupant. The penalization is 2.13%.

Distribution, as indicated by the CO_2 tests about the same as second floor and is given 81%, or a penalization of 5.7%.

This floor, as a whole, is given a rating of 87.30% and could be improved by providing a greater air supply and better distribution.

Tests Nos. 8 and 9, January 12 and 16, 1917.

Fifth Floor.

Chart for fifth floor compiled from Test Sheets 8 and 9 gives the following results:

Temperature, Humidity and Air Motion: Penalization is 7.65%, the temperature and relative humidity being too low.

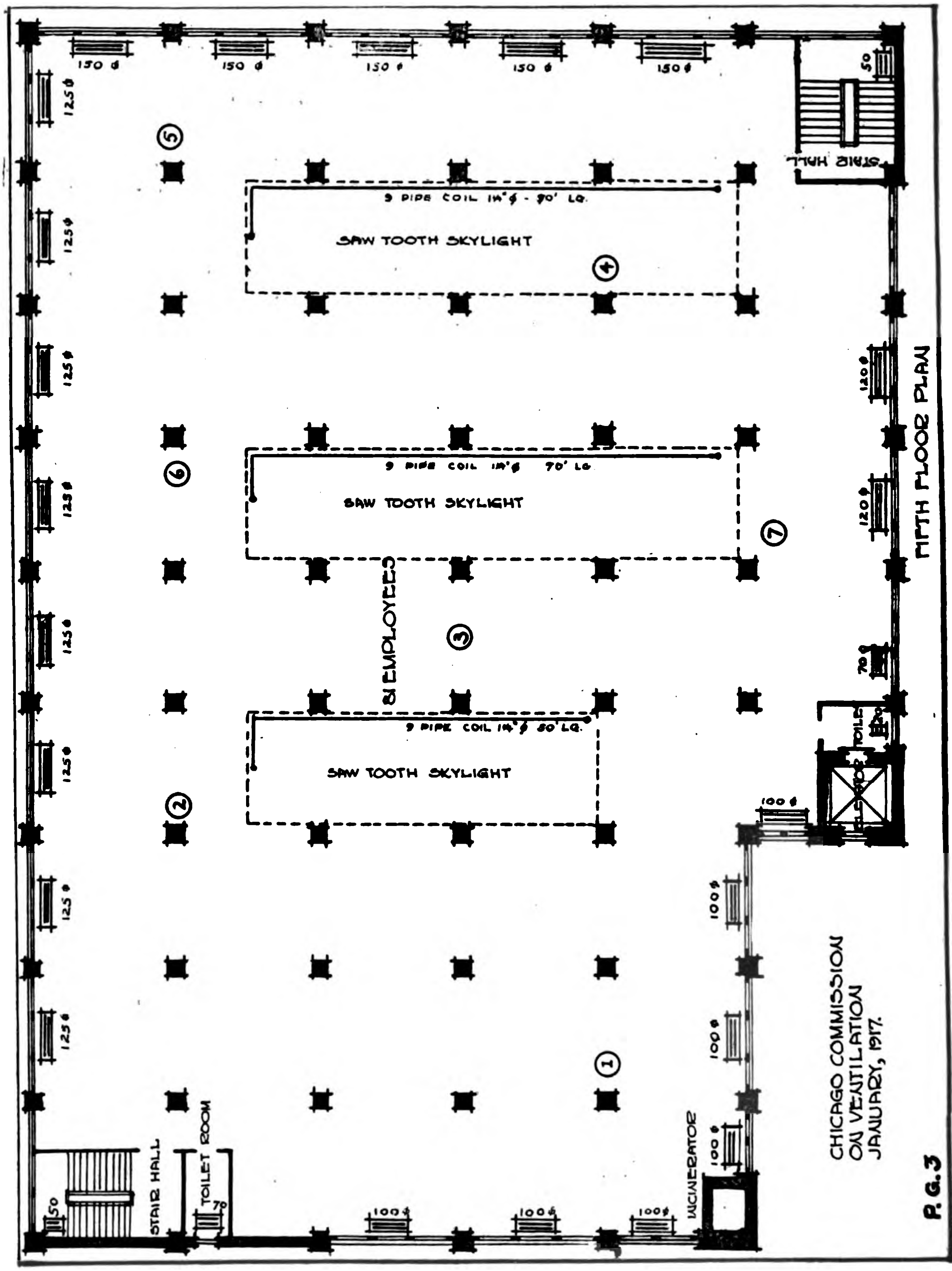
This, being the top floor and provided with natural ceiling vents as well as the two 36-in. exhaust fans, naturally loses a great amount of heat, and when the stairhall doors are closed, the cold draft near the windows is very objectionable. This can easily be improved by keeping the stairhall doors opened on all floors, as indicated, by results given in Test No. 12.

PARIS GARTER FACTORY Sheet No. RG-21

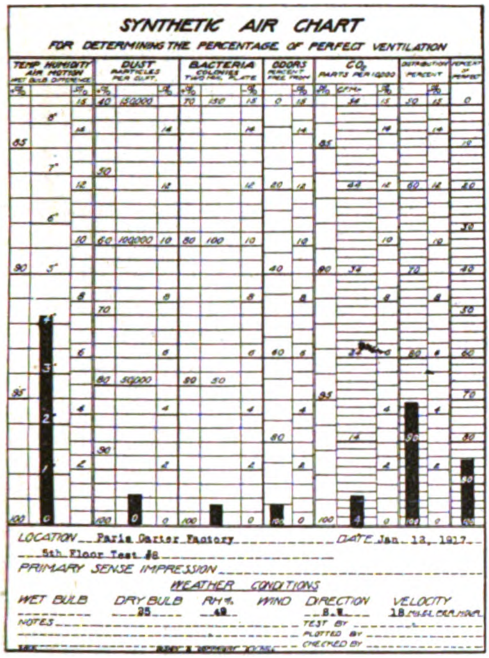
FIFTH FLOOR TEST No. 8 & 9 Jan. 12 & 16, 1917

Time	Occupants	Air Space per Occupant	Supply		Exhaust		Station	Temperature		Rel. Hum. %	Air Motion Ft. Per M.	Dust Particles Per Cu. Ft.	Bacteria 2 Min. Plate	Odors % Free from	CO_2	Weather Conditions			
			Vel. Ft. Per M.	Vol. C.F.M.	Vel. Ft. Per M.	Vol. C.F.M.		Dry Bulb	Wet Bulb							Temp.	R.H.	Wind Dir.	Wind Vel.
Test No. 8																			
2:35							1	62	48	32		5200	5		8.6				
TO							2						15		8.3				
2:52							3	63	49½	36		11200	5		6.8				
Jan. 12							4	63½	50	37		12300	6		9.0	DISTRIBUTION=85.5%			
							5						4		7.3				
							6	64½	51½	30		11800	15		6.7				
							7						5		5.4				
Ave.	81	2000		2200				63		34	10	10100	7.6	95	7.4	25	40	S.E.	18
Test No. 9																			
12:30							1	65	50	32			2		8.5				
TO							2						5		7.3				
12:50							3	65	49½	30			1		7.2				
Jan. 16							4	65	49½	30			7		8.3	DISTRIBUTION=82.7%			
							5						2		9.4				
							6	65	49	28			2		7.5				
							7						4		8.2				
Ave.	81	2000		2000				65		30	10	10100	3.3	95	8.0	25	49	S.W.	17

TEST SHEET, FIFTH FLOOR, TESTS 8 AND 9.

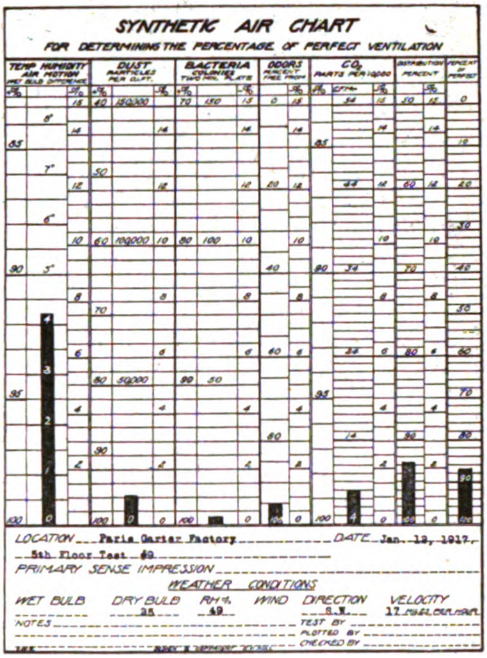


FIFTH FLOOR PLAN, PARIS GARTER FACTORY.



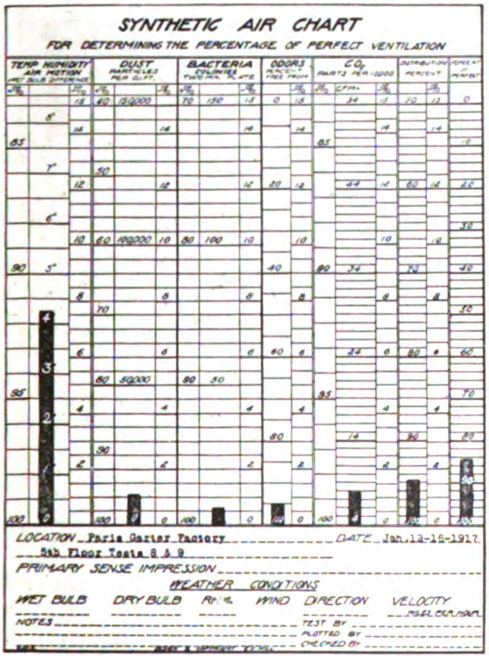
SYNTHETIC AIR CHART
FOR DETERMINING THE PERCENTAGE OF PERFECT VENTILATION

LOCATION Paris Garter Factory DATE Jan. 13, 1917.
5th Floor Test #8
PRIMARY SENSE IMPRESSION
WEATHER CONDITIONS
WET BULB DRY BULB 25 RH% 49 WIND DIRECTION S.W. VELOCITY 18 MILES PER HOUR
NOTES
TEST BY
PLOTTED BY
CHECKED BY



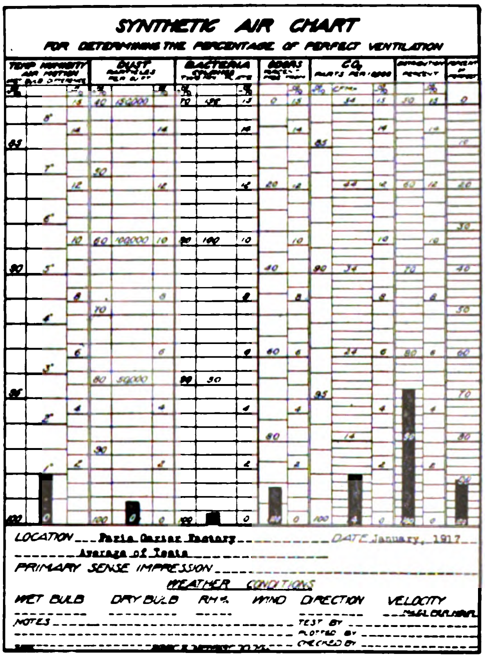
SYNTHETIC AIR CHART
FOR DETERMINING THE PERCENTAGE OF PERFECT VENTILATION

LOCATION Paris Garter Factory DATE Jan. 13, 1917.
5th Floor Test #9
PRIMARY SENSE IMPRESSION
WEATHER CONDITIONS
WET BULB DRY BULB 25 RH% 49 WIND DIRECTION S.W. VELOCITY 17 MILES PER HOUR
NOTES
TEST BY
PLOTTED BY
CHECKED BY



SYNTHETIC AIR CHART
FOR DETERMINING THE PERCENTAGE OF PERFECT VENTILATION

LOCATION Paris Garter Factory DATE Jan. 13-16-1917
5th Floor Tests 8 & 9
PRIMARY SENSE IMPRESSION
WEATHER CONDITIONS
WET BULB DRY BULB RH% WIND DIRECTION VELOCITY MILES PER HOUR
NOTES
TEST BY
PLOTTED BY
CHECKED BY



SYNTHETIC AIR CHART
FOR DETERMINING THE PERCENTAGE OF PERFECT VENTILATION

LOCATION Paris Garter Factory DATE January, 1917
Average of Tests
PRIMARY SENSE IMPRESSION
WEATHER CONDITIONS
WET BULB DRY BULB RH% WIND DIRECTION VELOCITY MILES PER HOUR
NOTES
TEST BY
PLOTTED BY
CHECKED BY

SYNTHETIC AIR CHARTS FOR FIFTH FLOOR TESTS NOS. 8 AND 9, AND AVERAGE OF TESTS.

FIFTH FLOOR, PARIS GARTER FACTORY, LOOKING NORTHWEST.

Dust: Penalization is 1.01%; about the same as the third floor.

Bacteria: Penalization is 0.55%; the same as second and third floors.

Odors: Penalization is 0.75%. The same as the second floor.

Air Supply averages 25.7 C. F. M. per person.

Distribution is given 89.1%, being a little better than the second and third floors and causes a penalization of 3.27%.

Average CO_2 (7.7) causes a penalization of 1.11%.

As a whole, this floor is given a rating of 85.66%, which could be greatly improved by raising the temperature and relative humidity of the room.

FIFTH FLOOR, PARIS GARTER FACTORY, LOOKING WEST, SHOWING SKYLIGHTS.

In the continuation of this report which will appear in the June issue, the results will be presented of a second series of tests (from Nos. 10 *to* 15, *inclusive) made with special reference to the effect of the exhaust fans and natural ventilators at the ceiling of the top floor on the air movement throughout the building. There will also be presented a discussion of both series of tests.*

Relation of Respiratory Diseases to Classroom Ventilation.

In order to obtain concrete evidence of the value of fresh air, especially evidence based on extensive observations with suitable controls, the Bureau of Child Hygiene in 1916 began an inquiry into the possible relationship between the prevalence of respiratory diseases among school children and classroom ventilation.* The study was made in cooperation with the New York State Commission on Ventilation, which had full control of the selection of the classrooms with reference to the type of ventilation to be included, the supervision of methods used in obtaining and recording all data concerning ventilation, and the final analysis of the results recorded

This investigation among 5,533 pupils in 76 classrooms in 12 schools operated under three different types of ventilation, conducted during a five-months period in the late fall, winter and early spring, forms the basis for the following conclusions:

> 1. In the closed window, mechanically ventilated type of classroom kept at a temperature of about 68° F., the rate of absences from respiratory diseases was 32% higher than in the open-window, naturally ventilated type of classroom kept at the same temperature (about 68° F.) and about 40% higher than in the open-window, naturally ventilated type of classroom kept at a temperature of about 50°F. In other words, the children in classrooms with closed windows and ventilated by mechanical methods were more subject to respiratory diseases severe enough to keep them from school attendance than were children who were in classrooms kept at the same or lower temperature and ventilated wholly by open windows.
>
> 2. In the closed-window, mechanically-ventilated type of classroom kept at a temperature of about 68° F., the rate of respiratory diseases occurring among pupils in attendance was 98% higher than in the open-window, naturally ventilated type of classroom kept at the same temperature (about 68° F.) and about 70% higher than in the open-window, naturally ventilated type of classrooms, kept at a temperature of about 50°. In other words, the children in classrooms with closed windows and ventilated by mechanical methods were more subject to respiratory diseases not sufficiently severe to keep them from school attendance than were children who were in classrooms kept at the same or lower temperature and ventilated wholly by open windows.
>
> 3. The relative humidity of classrooms, whether ventilated by natural or mechanical means, was not a causative factor in the occurence of respiratory illness among school children.

◆

New York Board of Health Interprets "Adequate Ventilation."

In interpreting the meaning of the term "adequate ventilation," as used in the sections of the sanitary code of New York City, relating to the occupancy of premises by persons, action in the enforcement of the code will hereafter be governed by the standards of ventilation adopted by resolution of the Board of Health on December 11, 1917. These are as follows:

1. Temperature—The temperature in rooms during periods of occupancy should register preferably from 60° to 70° F. at all times, except when the outside temperature exceeds 60° F. This does not apply to rooms used for special purposes, such as industrial places where high or low temperatures are essential and unavoidable.

2. Humidity—The relative humidity in occupied rooms should not exceed 70%, except when the outside bulb temperature exceeds 59°. In no case, however, should the wet bulb temperature exceed 78°.

3. Carbon Dioxide—The carbon dioxide in occupied rooms in all classes of buildings should not at any time exceed 10 parts in 10,000 volumes of air in any part of the occupied spaces of the rooms.

4. Dust—The dust particles in the air of occupied rooms in all classes of buildings should not exceed 1,000,000 per cubic foot, or 0.004 (4 miligrams per 100 cu. ft.).

5. Bacteria—The bacteria content should not exceed 100 per cubic foot.

6. Odors—The air of occupied rooms of all classes of buildings should be free from objectionable odors, which may be detected by persons entering the room from the outside air, whether the odors are of human origin or otherwise.

◆

Immediate Construction Urged of Vehicular Tunnel Under Hudson River.

The New York State Bridge and Tunnel Commission has recommended to the legislature the immediate construction of the vehicular tunnel under the Hudson River, which was described in the April issue.

The commission estimates that the tunnel could be built within three years at a cost of $12,600,000. It urges that had the tunnel been in existence last winter there would have been no coal famine.

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* "Classroom Ventilation and Respiratory Diseases Among School Children," by S. J. Baker, M. D., D. P. H., American Journal of Public Health, January, 1918.

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A. S. ARMAGNAC.....................*President*
GUSTAVE PETERSEN....*Secretary and Treasurer*

A. S. ARMAGNAC, Editor
GUSTAVE PETERSEN, Business Manager
HAROLD L. ALT, Contributing Editor

European Representative:
W. G. HOLLINWORTH, 304 High Holborn
London, W. C.

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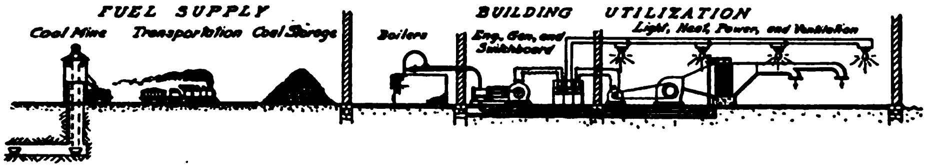
THE heating trade is about to experience one of the most remarkable campaigns for the extension of business that has ever been undertaken in this field. With the backing of all the important national organizations of manufacturers, supply dealers and contractors of heating and plumbing apparatus, the trade is being prepared for a four-months intensive effort for "new equipment in old buildings," under the slogan of "Building Bigger Business."

One has only to refer to the reports of building operations issued from month to month to know that construction work in this country is at an abnormally low level. So far, the government's vast building programme has more than made up for this deficiency, in total volume of business, but not in its general distribution. Some industries have increased their output to an extraordinary degree, while other "non-essential" industries have suffered to a corresponding extent. This is also true of the contracting end of the building trade. Those in the zone of the government's activities are being hard put to it to take care of the volume of work almost literally thrown at them, while those in the outlying sections, so to speak, are high and dry.

It is, therefore, a happy thought and one based on sound business sense that has prompted the national trade organizations to awaken the trade to its opportunities in the neglected field of re-equipping old buildings. The wonder is that this class of business has not attracted more attention than has been given it in the past. To consider only the construction during the past twenty years, there must be and there are literally thousands of structures of all sorts that are today in crying need of new heating and plumbing equipment. The problem of the hour is how to go after this business on a broad scale. It is obvious that the first step is a nation-wide publicity campaign in the representative trade journals. This will make a splendid beginning, but the work must not be allowed to stop there. Every heating contractor and every plumbing contractor must make it his business to boost the campaign among his patrons. Talk new equipment. Advertise it in your local papers. Single out those cases, which may be found in any community, where the prospects are especially good for interesting the owners in new and better heating and plumbing systems. Many householders will be found who have only the faintest idea of the comfort and luxury of a modern heating plant, to say nothing of the plumbing conveniences that are now offered.

"Building Bigger Business" means more profits for every one in the trade. So let us all get in on this movement. The manufacturers are doing their part. It is for the rest of the trade to back their efforts by carrying the message home in every locality, not next month or next Fall, but —*Now.*

POWER PLANT ENGINEERING



The Need of the Building Power Plant in War Times

The recent coal shortage has been seized upon in some quarters as a reason for renewing the agitation for the elimination of isolated plants in favor of central electric power stations. The fuel conservation authorities are being told that a saving in coal consumption can be made by forcing the shutting down of all the isolated plants in central station districts and the supplying of electric current from the central plants.

In discussing the merits of this proposition, it should be stated at the outset that there are and always will be cases where the conditions will warrant the use of central station service. It is desired, however, to consider here the reasons generally brought forward why an individual power plant should not be installed when central station service is available. These reasons may be summed up as follows:

ARGUMENTS AGAINST INDIVIDUAL PLANTS.

1. The individual plant cannot be installed at the cost estimated.
2. It cannot be operated at the cost expected.
3. Some invention may revolutionize the methods of power-production, making the investment in the private apparatus valueless and necessitating the scrapping of the whole equipment.

These main points are in addition to local arguments, such as the danger of having high-pressure boilers in a building, the likelihood of breakdowns, etc.

It is well known and easily understood that an isolated plant would not be a paying investment in a private residence. The cost of the amount of current used in a year would not pay a man's wages for one week to look after the power-producing apparatus. Similarly, for a two-family house, and smaller tenements. But when office buildings, railroad stations and group buildings are considered, this statement ceases to be true. What the actual economies will be in such cases will vary in each instance and with the local conditions under which the plant would have to be operated.

OVERALL COAL CONSUMPTION THE VITAL FACTOR.

When one states that it is possible to save in operating cost by installing an isolated plant, it is necessary to show that the overall coal consumption will be less, for the following reasons:

(*a*) The cost of the small plant per kilowatt is higher than the large central stations and, therefore, the interest on the investment must be higher, as well as the depreciation of the equipment.

(*b*) The cost of labor is higher per kilowatt in the small plants, as an engineer and fireman have to be employed for each plant regardless of how small it may be, while the central stations, with their large units and big kilowatt production, have a much smaller labor charge per kilowatt developed.

(*c*) The efficiency of the small plants, kilowatt for kilowatt, when compared with the large central stations, is liable to be somewhat less.

Now the cost of operating the small plant is composed of the following items:

Interest on investment.
Depreciation.
Labor.
Miscellaneous Supplies.
Repairs.
Coal.

If it is admitted that (per kilowatt) the small plant has a greater interest charge to meet, a higher labor charge, a bigger depreciation and a lower efficiency, and if, in spite of all these facts, the small plant can come through the year without a loss (to say nothing of making a saving, as many of them do) wherein is the difference made up? Certainly *not* in the supplies or repairs (which are of small financial moment) but in the only remaining item, *the coal pile.*

It will be noted that the central station companies, in pointing out their higher efficiencies *in their power houses* are very apt to overlook the transmission losses in their *distribution lines* which in themselves are sufficient to overcome any reasonable difference between the efficiency of the large station and that of the small plant, unless under very unusual conditions. Therefore, it becomes a pertinent question to ask whether a kilowatt can be delivered at the building with the consumption of any less coal by the large central station than by producing it on the premises.

Whether the foregoing question is answered "Yes" or "No" an even more important question looms up in connection with the matter of heat. In the present discussion we are only considering those central stations that do not make any effort to supply heat. The small building power plant almost invariably operates so as to utilize the heat in its exhaust either to heat the building, furnish hot water for service, steam for refrigerating, or in other ways. On this account practically no coal at all is burned to supply power during the heating season. As this involves the six months of the year during which the shortest and darkest days occur, the coal required to supply power during the summer months will not have to furnish half the yearly consumption by any means; probably one-third would be more nearly correct.

TYPICAL SUMMARY OF CENTRAL STATION OPERATION.

The following summary is a fair average of the way the central stations operate:

TABLE 1—TYPICAL OPERATING SUMMARY.

Steam-Turbo Electric Stations.

Coal 14,000 B.T.U., 190 lbs. pressure, 125° F. superheat, 190° F. feed.

B.T.U. required to generate a pound of steam—heating from

190° to 384°	198 B.T.U.
Evaporating at 190 lbs. pressure	842 B.T.U.
Superheating 125° (mean superheating 56°)	70 B.T.U.
Total	1100 B.T.U.

Average overall furnace and boiler efficiency, 60%.

Effective B.T.U. per pound of fuel,—8400 B.T.U.

Pounds of steam generated per pound of fuel, 7.56 lbs.

Used in turbines	19 lbs.
Used in auxiliaries	3 lbs.
Total water per hour	22 lbs.

Pounds of coal per kilowatt generated, 2.91 lbs.

SUMMARY HEAT STATEMENT.

Total heat contained in coal, 2.91 × 14,000	40,700 B.T.U.
1. Efficiency of transformation of chemical energy to heat, and (2) efficiency of transmitting heat to water, 60%, leaving	24,000 B.T.U.
3. Efficiency of transforming heat to mechanical energy, 15.6%, leaving	3,600 B.T.U.
4. Efficiency of transforming mechanical to electrical energy, 90%, leaving	3,420 B.T.U.

Overall heat efficiency of station, 3420/40,700, or 8.4%.

From this table it does not look as if the large central stations were such large savers, after all, for of every pound of high-grade coal they burn, only 8.4% is utilized and the transmission line losses may cut this to 7.5% or 8%, flat.

Suppose the building power plant has an efficiency of only 80% of that attained by the central station,—and even the central station enthusiasts would hardly go below that figure for an average—then for every pound of coal burned for power during the summer the efficiency would be 8.4 × 75%, or 6.3%. During all of the non-heating months the plant would have a heat efficiency of 6.3%, this being the number of B.T.U. actually turned into electric current and delivered at the switchboard. But during the heating season, the heat efficiency will be 6.3% *plus whatever exhaust is turned into the heating system* (the exhaust seldom containing less than 60% and more than 65% of the total heat) so that the winter efficiency is at least 6.3% + 60%, or 66.3%. If the average winter load runs 50% more than the average summer load, then one-third of the total kilowatt hours are furnished in the summer and two-thirds of the total kilowatt hours are furnished in the winter. The average efficiency will then be:

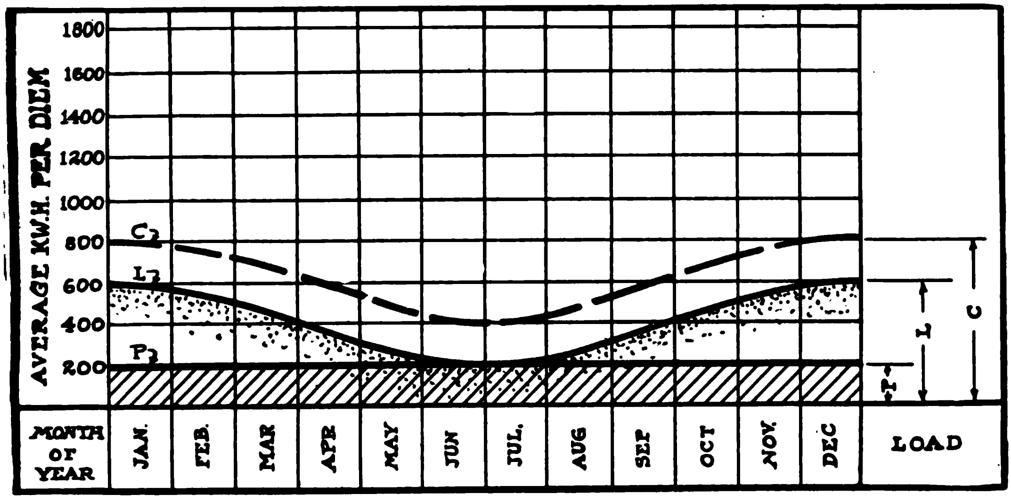


FIG. 1—TYPICAL BUILDING POWER PLANT LOADS FOR ONE YEAR.

$6.3 \times 6 \text{ months} \times \frac{1}{3} = 12.6$
$66.3 \times 6 \text{ months} \times \frac{2}{3} = 265.2$

277.8

$277.8/12 = 23.1\%$ average yearly efficiency.

DATA FROM A TYPICAL BUILDING.

The main subject for discussion, however —pounds of coal per year—should not be allowed to become buried under the matter of efficiency. Good or poor efficiency is of secondary importance at the present time unless affecting the coal used per kilowatt delivered.

For the purpose of illustrating the comparative efficiency of a central station plant as compared with an individual power plant, a typical building has been assumed, the power loads being as indicated in Fig. 1. Here the power load, P, has been shown as fairly constant throughout the year, while the light load, L, has been assumed to vary from the minimum during the longest days in summer to the maximum of three times as much during the shortest days in winter. Whether this is exactly correct proportion or not is immaterial, as the point desired to be brought out is the fact that the winter lighting load is much heavier than the summer; probably the ratio in many cases would run one to six or even one to ten.

The sum of the power load, P, plus the light load, L, equals the combined load, C, or

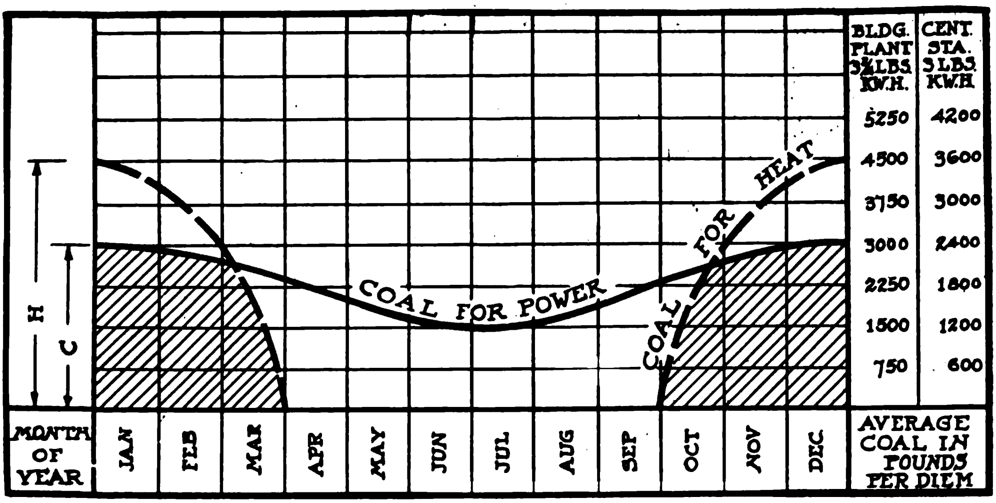


FIG. 2—BUILDING POWER LOAD AND HEATING REQUIREMENTS. BOTH PLOTTED IN POUNDS OF COAL.

$$P + L = C$$

From this curve, C, it can be seen that at its highest point, about December-January, it reaches a maximum daily average of around 800 Kw. H., which would indicate a plant capacity of somewhere in the neighborhood of 200 Kw.

On the chart shown in Fig. 2 the combined load, C, obtained in Fig. 1 is plotted as pounds of coal; on the left-hand side the first scale shows the pounds of coal required at 3¾ lbs. per kilowatt hour (if produced in the building) and the second scale, the number of pounds of coal required at 3 lbs. per kilowatt hour (if produced in a central station). The reason for the adoption of the 3 lb. and 3¾ lb. figures is as follows:

The central station produces a kilowatt hour with a fraction less than 3 lbs., as has already been seen in Table 1, and, therefore, the 6 lbs. is approximately correct. The building plant, with a lower efficiency—say 80% of that attained by the central station—produces the same kilowatt hour with 3¾ lbs. of coal, thus:

Central station = 3 lbs. coal ÷ 3 lbs. per kilowatt hour = 1 Kw. H. produced while
Building plant = 3¾ lbs. coal ÷ 3 lbs. per kilowatt hour × 80% = 1 Kw. H. produced.

Therefore, whether these figures may be a fraction above or a fraction below the mark is not essential as long as they are relatively correct.

On this chart is also plotted the average daily pounds of coal required for heating from October 1 to April 1; this is based on the assumption that the maximum average heating load, H, on the coldest day, is 50% greater than the maximum average power load during the same period, so C + 50% C = H. In many buildings the ratio is much higher, but this would increase the shaded area slightly which would be to the further advantage of the building plant, as will be seen later.

The shaded portion indicates the number of kilowatt hours during the year for which the coal *necessarily burned to heat the building* can be utilized in a building plant to supply heat, light and power at the same time. The chart demonstrates very clearly that during the months of November, December, January and February, no additional coal need be purchased for power, while in October and March a small portion only will be required.

The chart shown in Fig. 3 is a comparison in pounds of coal of the two alternate propositions; *viz.*, the supplying of the building's combined power and light load, C, by the building plant, B, giving the curve CB (a reproduction of the curve for power in Fig. 2) and the furnishing of its heat, H, by the same building plant, B, giving the building heating curve, HB, together with the alternative proposition of furnishing the combined building load, C, from a central station, C, at higher efficiency, giving the lower curve CC, on top of which (during the winter months) all the coal for heating, H, must be added, giving the resultant curve, HC.

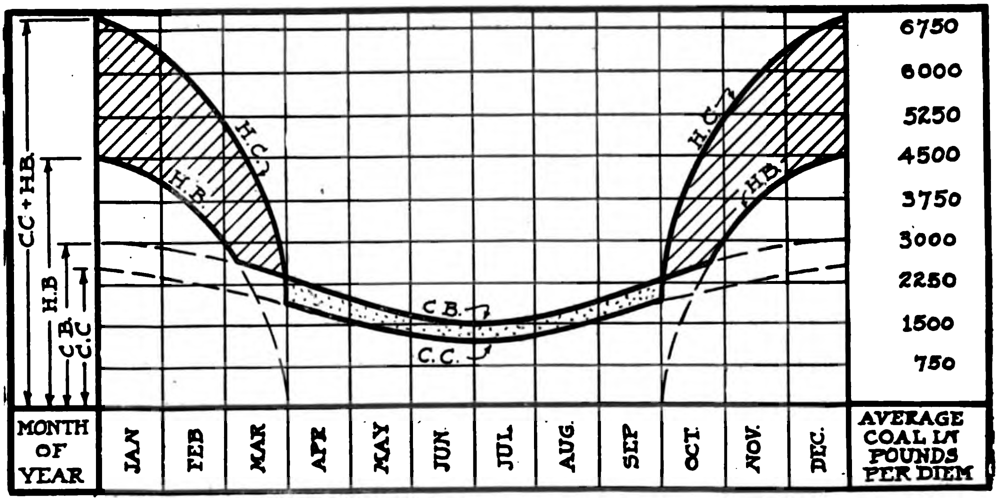


FIG. 3—COMPARATIVE COAL CONSUMPTIONS WITH A BUILDING PLANT AND WITH CENTRAL STATION CURRENT.

The area of the chart below the curves represents the quantity of coal consumed under each proposition and it is self-evident that during the winter the central station service—considering also the coal burned in the building for heating—would result in an increased consumption, since, with the building plant, the daily average would be only HB, while with central station service the daily average would be CC + HB.

On the other hand, during the summer months the chart shows a saving in the daily coal average, due to the increased central station efficiency. The shaded area indicates the winter increase in coal and the dotted area the summer decrease by using central station power. If the total shaded area is greater than the total dotted area, the central plant requires the expenditure of more coal in winter than it saves during the summer and is, therefore, a net loss. If the dotted area exceeds the shaded portions, then the central station saves more in the summer than it requires additional during the winter, and is than accomplishing a net saving.

It is doubtful if the public service companies can deliver at the building at the high efficiency with which they are credited on the chart. If, considering the transmission loss, their overall efficiency at the building drops to a point where it is only equal to the building apparatus at its own switchboard, then the curve, CC, will superimpose on the building curve, CB, the dotted area will be wiped out and the central station has a winter heating loss to overcome with nothing to apply against it.

It would seem, therefore, that with every advantage claimed by the central station advocates, the central station cannot compete against the average combined building power and heating plant on the basis of efficiency. Neither can the central station produce a net saving in coal required during the year (when the heating and power requirements of a building are both considered) even if it can deliver a kilowatt at the building with less coal consumption than if developed in the building.

To sum up, the shutting down of the building plants, instead of making a coal saving, would result in the actual consumption of more coal in every plant operated on a reasonably efficient basis. It has also been shown that the central stations are offenders in the matter of coal conservation in throwing away in their condenser water about 60% of the available heat in every pound of coal burned, which heat is carried off to the river, lake, spray pond, or other cooling means where it is lost as far as heat conservation is concerned.

Space Requirements for Engines.

In the article on "Space Requirements for Engines," which appeared in the March issue in the department on "Power Plant Engineering," it should be noted that all of the engine dimensions given refer to Fig. 1 herewith. Fig. 2 refers to right-hand and left-hand engines mentioned in the same article. These two drawings were inadvertently omitted from the article.

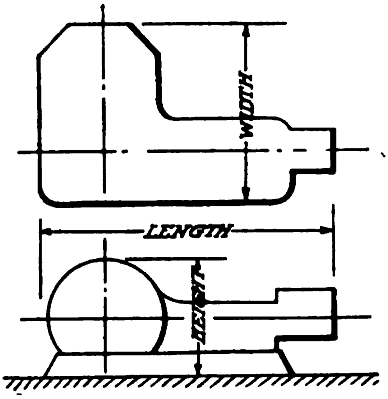


FIG. 1—DIAGRAM OF ENGINE DIMENSIONS FOR USE WITH TABLES IN MARCH ISSUE.

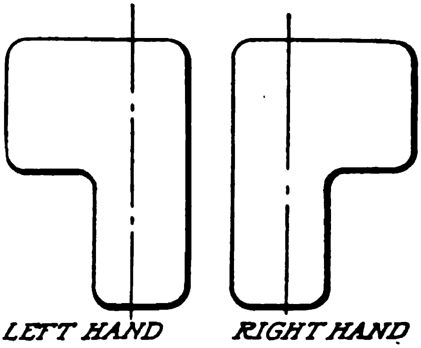


FIG. 2—LEFT-HAND AND RIGHT-HAND ENGINE DIMENSIONS.

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To Harness Country's Water Power.

By sweeping majorities 500,000 business executives who comprise the membership of the United States Camber of Commerce have adopted resolutions calling on Congress to make provision for harnessing the millions in water horse power that now run wild.

Americas' Coal Problem in 1918

One of the most important documents, from a practical standpoint, issued by the United States Fuel Administration, is that which appeared early in April, under the title of "America's Coal Problem in 1918." It is written by Fuel Administrator Harry A. Garfield, and states in unmistakable language the warning of the fuel administration that "consumers must buy their winter supply of coal during the spring and summer for storage during the winter if the production is to be maintained at a maximum and the country enabled to avoid a serious coal shortage this winter."

The fuel administration, it is stated, guided by the experience of the past winter, has taken the necessary steps to clear the way for the ceaseless activity of the mines of the country in increasing the supply and for the steady, swift distribution of the nation's fuel as rapidly as it can be taken from the ground and moved over our overburdened transportation systems. The prices fixed by the government for coal at the mine have now been established on a stable foundation which will not be disturbed during the coming year, except in cases of extraordinary urgency. Finally, by carefully-drawn regulations, the fuel administration has insured the shipment of "clean coal" from the mines. Coal containing an undue amount of foreign matter wil be penalized in price and producers who take extraordinary measures in the preparation of their coal will be recompensed.

Through the zone system, which became effective April 1, the movement of bituminous coal between the mine and the consumer will be restricted to the shortest possible transportation lines consistent with the maintenance of an adequate and proper coal supply to all consumers.

Emphasis is laid by Fuel Administrator Garfield that the great storage capacity of the country lies in the bins of the individual consumer and there the country's coal reserve must be built up during the spring and summer when coal production is unhindered and the transportation facilities of the country operating at their highest efficiency. As an inducement to "early buying," the prices of anthracite coal have been reduced 30 cents a ton on all domestic sizes from April 1 to August 31, and in many of the bituminous fields prices have been cut to an even greater extent. To safeguard the consumer the fuel administration has prescribed regulations to prevent profiteering and to govern the distribution of coal by licensed jobbers and by retailers. Each domestic consumer will be permitted to secure a full normal supply of coal, but no more.

New Priorities List for Coal.

In accordance with a new priorities list published by the United States Fuel Administration, for the distribution of coal and coke, certain preferred industries will be given preferential treatment by the fuel administration, including transportation by the railroads. These industries include domestic consumers, plants manufacturing electrical equipment, public institutions and buildings, public utilities, railways, and shipbuilding plants. Automobile plants are not on the list.

Zone System for Distribution of Bituminous Coal.

Beginning April 1, 1918, an announcement of the United States Fuel Administration states that a zone system will govern the distribution of bituminous coal during the coal year beginning on that date. Heretofore coal has been distributed practically without regard to the distance between the mine and the consumer. Under the zone system coal will be distributed to a consuming territory under restrictions that will avoid, as far as possible, waste of transportation facilities, but nevertheless consistent with the maintenance of the greatest possible production and a proper coal supply to all coal users. Every effort has been made however, to preserve long-established trade relations. The actual working of the zone system will be that ordinarily any one section's coal supply will be derived from mines relatively near, thus preventing abnormal and wasteful transportation movements. In this way, eastern coal will be restricted to eastern markets, and the central and western states will be supplied with nearby coal produced in those States.

In addition to the saving in transportation it is estimated that this system will provide for the possible retention of something like 5,000,000 tons of coal for Eastern States which heretofore has gone west by rail. About 300,000,000 tons of bituminous coal will be regulated by the zone system, or 60% of the total production. Based on this production, there will be saved on the round trip from and to the mines almost 160,000,000 car-miles. This will permit the same cars to make almost 300,000 additional trips from the mines, equivalent to an increase of 5% in the production. Coal for movement on inland waterways is in no way restricted by the system, nor is coal delivered to Canada, which is subject to the regulations of the fuel administrator.

The limitations imposed upon the movement of bituminous coal are given in detail in Publication No. 21, issued by the United States Fuel Administration which also treats, under a separate heading of the "effect of zone system on distribution of bituminous coal by consuming States."

Amount of Coal Saved by Various Economies.

An analysis of the actual amount of coal that can be saved by lighting curtailment, as well as by reducing the indoor temperature from 70° F. to 69° F. and by saving one shovelful per day per family, has been made by Preston S. Millar and presented at a special meeting of the Illuminating Engineering Society in New York, on February 14.

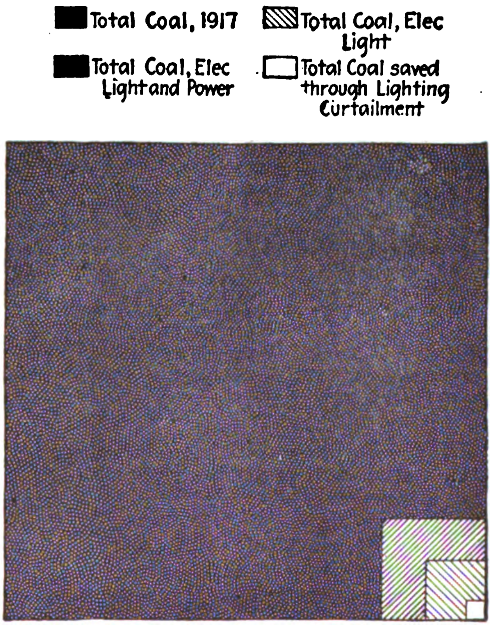
The results of Mr. Millar's analysis are shown in the accompanying charts. The cost of artificial illumination of all kinds, he says, is 0.5 to 2% of the total expenditure of the people. The significant figures to have in mind in discussing this subject are as follows, all being rough approximations: Total coal output of the country, 640,000,000 tons; total employed in production of electric light and power (traction excluded), 36,000,000 tons; total employed for production of light by electricity, 12,000,000 tons. According to these estimates, about 2% of the coal consumption of the country goes into electric light. Fig. 1 gives a graphic comparison between the foregoing figures and the estimated coal saving possible by lighting curtailment. At the same time Mr. Millar emphasizes the desirability of eliminating the unnecessary use of lights.

The adoption of summer daylight saving, as now proposed, is estimated to be capable of reducing the coal consumption of electric central station steam plants by 230,000 tons per annum for the entire country. A suggestion to advance the period of activity by one hour the entire year round, which is now attracting considerable attention, is estimated to afford about the same saving to the public in lighting bills, but to result in a somewhat greater saving of coal on account of the more favorable load factors for the power plants, which would result in the winter months.

The inherent lower efficiency of small plants, together with less expert operation, which in general they receive, is estimated to be responsible for the use of one-third more coal than necessary.

If a proportional amount of coal saving equivalent to 7% of the total electric light produced be assumed, this would mean a reduction in coal consumption of 840,000 tons per annum. This is the maximum extent to which it is believed that the best interests of the public requires coal to be saved through electric-light curtailment. Such a saving compares with other possible annual savings as follows:

Total savings which must be accomplished, 50,000,000 tons; net savings thought desirable through curtailment of electric lighting, 840,000 tons; savings if one degree lower temperature is adopted for building interiors, that is, 69° instead of 70° F., 3,000,000 tons; and saving if each family decreased by one

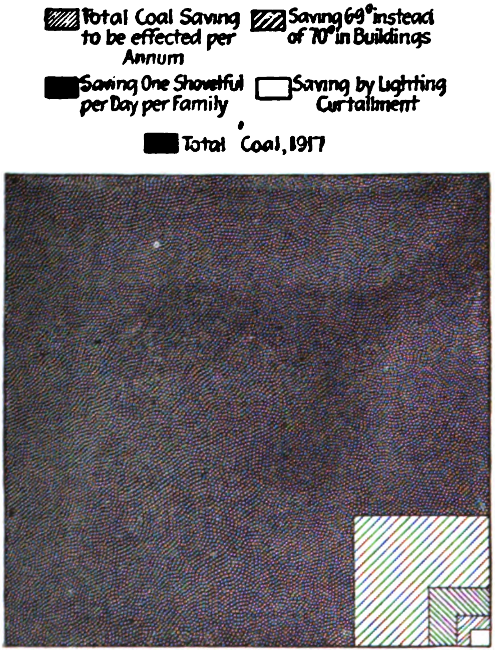


From Power.

FIG. 1—TOTAL COAL PRODUCTION AND COAL CONSUMPTION OF THE COUNTRY FOR LIGHT AND POWER.

shovelful its daily use of coal, 15,000,000 tons. A graphic comparison of these figures is given in Fig. 2.

The saving which is possible in the heating of buildings looms large. Our practice in this respect is to heat buildings to a considerably higher temperature than is done in Europe. The coal which might be saved by operating buildings at temperatures which prevail in Europe, instead of at the temperature which we affect, would be more than the equivalent of the entire consumption of coal in electric lighting. Even the saving of one shovelful of coal per day makes any practical saving through electric lighting curtailment seem very small.



From Power.

FIG. 2—TOTAL COAL PRODUCTION AND COAL SAVINGS BY VARIOUS CURTAILMENTS.

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Unique Boiler Selling Campaign.

A selling campaign out of the ordinary has been inaugurated by Pierce, Butler & Pierce Mfg. Corporation for the sale of the Pierce down-draft boiler. According to the company's announcement it proposes to make a cash allowance for old boilers when replaced by the Pierce down-draft heater, very much as automobiles are traded in for new cars.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Committee to Develop Furnace Code.

In accordance with the action taken at the annual meeting of the heating engineer's society that the society compile a code for warm-air furnace heating, similar to the society's new heating boiler code, President F. R. Still has appointed the following committee to develop such a code:

General chairman, John R. Allen. Design: J. R. McColl, chairman; J. H. Bacon, A. R. Hardy, Roy E. Lynd and William R. Murphy. Installation: E. H. Lockwood, chairman; R. H. Bradley, Frank K. Chew, Frank I. Cooper and S. R. Lewis. Testing: Arthur C. Willard, chairman; F. H. Boomhower, B. H. Carpenter, P. J. Dougherty and M. J. Lide. Code: F. J. Pryor, chairman; John E. Henry, Conway Kiewitz, William W. Underhill and F. W. Williamson.

Changes Being Made in Heating System for Camp Funston.

Some of the changes that have been found necessary in the heating system for Camp Funston, Kansas, were described in a paper on "Heating Army Camps and Cantonments," by B. Natkin, read before the Kansas City Chapter of the heating engineers' society.

As the heating system was originally installed, steam is supplied by a system of overhead mains supported on poles and the condensation from each building has been wasted. It has turned out, however, that the lack of an abundant supply of water, together with its large percentage of scale, has made it necessary to install a return line system to save the condensation. The government has made an appropriation of $150,000 for these lines which are now being installed. They run to a central low point in each unit where the condensation is collected in an electric pump and receiver which, in turn discharges the water into the boilers. "It is quite probable," says Mr. Natkin, "that had the government engineers foreseen the necessity of underground return lines, they might have put the steam lines also underground, as it would have proven less expensive than the present system of overhead lines and underground returns."

As to the general proposition of using

overhead supply lines, Mr. Natkin said that in addition to the advantage that overhead lines are cheaper to install, they can be readily got at for repairs and the material can be obtained more readily. If the lines were laid underground it would have necessitated miles of trenching, suitable underground covering, such as wood log or insulated tile, a parallel return main, with traps, to take off the condensation in the mains, and a drainage system for keeping the line dry. Then there would be the greater difficulty of repair. Mr. Natkin added that the condensation in the overhead line is but very little greater, as installed in the camp, than occurs in an underground line.

STEAM HEATING FOR BARRACKS.

At Camp Funston the barracks are heated by steam, every three or four radiators being connected in a row at the bottom by a 2-in. pipe, in what is known as the railroad system, the steam feeding from one radiator into another. Mr. Natkin stated that the heat loss factors used in estimating the required radiation were: 88 B. T. U. loss per hour per square foot of glass; 24 B. T. U. loss per hour per square foot of exposed wall; 1.43 B. T. U. loss per hour per cubic foot of contents. The loss through the roof was disregarded as there is a dead space 4 in. between the beaver board and the roofing through which the air does not circulate. On this basis the second story of a barrack would require 762 sq. ft. of radiation and 810 sq. ft. was installed. The first story would require 380 sq. ft., and 385 sq. ft. is installed. The entrance hall figures 61 sq. ft. and two radiators containing 40 sq. ft. were installed. The mess hall is heated by six radiators, containing 50 sq. ft. each, while the rule would give 280 sq. ft. as the required amount. The factors of north and west exposures, Mr. Natkin said, were not taken into account in the foregoing figures, as the various barracks have different exposures for the same corresponding side.

New York Chapters Elects New Officers.

Another successful year for the New York Chapter was brought to a close April 15 when the chapter held its annual meeting at the Building Trades Employers' Club, New York. Secretary Obert reported an increase in membership and the treasurer, William J. Olvany, reported a balance at the close the year of $131.00.

The following names were proposed by the nominating committee as officers for the ensuing year, all of whom were elected: President, P. H. Seward; vice-president, Perry West; treasurer, William J. Olvany; secretary, C. W. Obert. Governors: Frank W. Chew, Thomas Chester and W. L. Fleisher.

The subject for discussion was the coal allotment per family, for next winter, with special reference to the preparation of suggestions that could be sent to the United States Fuel Administration and possibly be adopted by the fuel administration. Frank T. Chapman was chairman of the committee in charge of the meeting. He outlined the action taken at the last annual meeting of the engineers' society when a committee was appointed to consult with the Bureau of Mines on the subject of coal allotment. At that time it was suggested that a fair allotment would be ¼ ton per room per month for the three coldest months and 1/5 ton per room per month for the three other winter months. Mr. Chapman said that on further consideration it was now the opinion of the committee that an average of 1½ tons per room per month throughout the six months of the heating season would be a better basis. In this reckoning bathrooms are to be considered as half-rooms, service rooms as half-rooms and halls as single rooms.

Mr. Chapman said all the evidence was pointing to another shortage of coal next winter so that it will be necessary to devise some plans for economizing in coal. If the society does not make concrete suggestions, the fuel administration will proceed on its own basis. He spoke of the present use by the fuel administration of coal cards on which coal deliveries are now being based and stated that while this plan was better than none,, it did not offer the best solution of the problem.

In the ensuing discussion it was brought out that the plan of 1½ tons per room is based on New York weather conditions. For other localities a factor would have to be used. Another speaker brought out the point that the number of occupants of a room is a factor and that a distinction should be made in the character of the rooms, since bedrooms would not require as much heat as living rooms. Mr. Chapman stated that the average of 1½ tons took care of this, although it was evident that for very small houses some special rule would have to apply, or else the formula would give such houses altogether too much fuel.

The discussion then turned on the amount of fuel that should be allowed for cooking purposes and Mr. Oaks stated that an average consumption would be 500 lbs. of coal per month for a single-oven range and 700 lbs. for a double-oven range, also 750 lbs. per month for cooking and hot water service for a family of five or more, and 500 lbs. for a family of less than five.

Several suggestions were made as to the need of educating the public in the operation of heating apparatus and one speaker urged that a full set of rules be printed on the card that would be sent out. Mr. Chapman stated that the committee had already considered this and that any recommendations sent to the Bureau of Mines would include the committee's suggestions for a set of rules and that the points brought up at this meeting would no doubt offer further suggestions to the committee..

Eastern Pennsylvania Chapter.

New officers were elected as follows at the annual meeting of the Eastern Pennsylvania Chapter, held March 14, at the Engineers' Club, Philadelphia: President, E. T. Murphy; vice-president, C. V. Haynes; secretary, A. P. Goldsmith; treasurer, H. P. Gant; board of governors: W. G. R. Braemer, J. D. Cassell and M. W. Franklin. A patriotic address on "Our men, over there! their base, over here!" was delivered by Joseph A. Steinmetz.

Fuel Session at Forthcoming Meeting of Mechanical Engineers.

During the forthcoming meeting of The American Society of Mechanical Engineers, in Worcester, Mass., June 4-7, an important session will be devoted to fuel combustion. The fuel session is scheduled for Thursday morning, June 6, at the Worcester Polytechnic Institute, and will be devoted to five-minute presentations of data relating to fuel economy. This session was planned by the fuel conservation committee of the Engineering Council to assist the United States Fuel Administrator in his nation-wide campaign for fuel economy.

The topics to be discussed are: 1. What are the economic defects of impurities in coal? 2. To what extent is fuel oil likely to be used as a substitute for coal? 3. How can soft coal be burned without smoke in marine boilers? 4. What are the possibilities in the direction of the utilization of anthracite wastes? 5. What instruments are useful and desirable in the boiler-room as aids in saving coal? 6. What is essential to the economical operation of hand-fired boiler furnaces when using soft coal? 7. To what kinds of plants and coals are the different types of mechanical stokers respectively adapted, and what is the limiting factor to their use in small plants? 8. What experience have you had in the use of wood as fuel? To what extent is wood available as a fuel? 9. What coal economies can be effected in residence heating? 10. What coal economies can be effected in the small steam plants? 11. What experiences have you had with the storage of coal?

Other subjects on which short papers are desired were "to what extent and where will the gas producer be used to produce economics?" and "What are the new and important devolopments in methods of burning coal?"

Annual Meeting of British Heating Engineers.

In spite of the war, the Institution of Heating and Ventilating Engineers held a successful meeting in London on February 14, at which the new president, Edgar Herring, assumed the chair.

It was announced that elaborate and successful experiments had been carried on at the University College during the year by the institution's research committee, and that the grant of £450 from the advisory council of the government Department of Scientific and Industrial Research had been paid over, while an additional £200 had been contributed by members.

Membership dues in the institution were increased from one to two guineas.

President Herring presented a carefully-prepared paper on "Our Coal Resources, and their Future Economical Utilization, Viewed from the Standpoint of the Heating Engineer." One of the points brought out by Mr. Herring was that the consumption of coal per head of population is 4.72 tons per year in Great Britain, 3.92 tons in Germany and 5.15 tons in the United States. It was pointed out that the climatic conditions in the United States would account for the higher figure for this country so that relatively there is a striking similarity in the net home consumption per head.

Mr. Herring then took up the question of fuel economy in connection with the practice of heating. After citing the well-known causes of fuel losses, including improper design of boilers, installing boilers of insufficient capacity, failure to use draft-regulating appliances, etc., he said that "as heating engineers, responsible for a very appreciable percentage of the fuel consumption of the country, it is necessary to urge upon architects and others the grave necessity of a careful consideration, from heat-conserving point of view, of the materials to be used and the methods of construction adopted in the erection of all classes of buildings. As engineers it is their duty not only to make themselves acquainted with the transmission coefficients of all kinds of building materials, but also to collaborate with architects in the endeavor to secure the erection of buildings in which the heat loss factor is reduced to a minimum. Every engineer is aware that a factory or workshop with an abnormal amount of glass surface, light roof construction (sometimes corrugated iron only) and comparatively thin walls (often of concrete 4 in. thick) cannot possibly be efficiently warmed otherwise than by the provision of a vast amount of heating surface and the consumption of an excessive quantity of fuel."

Mr. Herring called attention to the failure to make greater use of exhaust steam for heating purposes, as well as for boiling liquids, drying, etc. He said we would be astounded at the waste of fuel involved if we could know the annual thermal value of the steam blown into the atmosphere from innumerable engines, pumps, defective steam traps and similar units. He concluded by advocating that proper facilities be provided at technical schools for qualifying men as certified stokers and that this might be accomplished by a course of instruction in the principles of combustion and the practical firing of boilers.

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American Association of Engineers.

A proposed plan whereby all the national engineering societies may co-ordinate their efforts will be one of the things brought up at the annual meeting of the American Association of Engineers, which will be held at the City Club, Chicago, May 14. In a referenda ballot sent out, to be returned in time for the meeting, special attention is called to the proposal of the government to establish an "American Academy of Engineers." A bill to this effect has already passed the United States Senate (S. 2360) and is now before the House (H.RR. 4625).

Acording to the bill the Academy is to be composed in the first place of fifty prominent engineers, the purpose being "to further the interests of engineering, industrial technology and applied science." It is further provided that the Academy shall consist of not more than 200 regular members and that it shall be ready at the call of the government to undertake any examination, experiments, etc., upon any subject of engineering, science, or art, the expenses of which are to be paid by the government. Finally the Academy is authorized to receive donations or bequests up to $1,000,000.

The board of directors of the American Association of Engineers has gone on record as stating that the Academy, under its proposed organization, would amount to "an aristocracy of engineers," as "this bill puts it into the power of a group of men who have attained distinction in the engineering profession, to further glorify themselves and to bring into the charmed circle only the men of their choice. It limits for all time the number of the elect to 200."

NATIONAL ASSOCIATION OF MASTER STEAM AND HOT WATER FITTERS

Master Steam Fitters to Meet in Chicago.

Announcement has been made that the twenty-ninth annual convention of the National Association of Master Steam and Hot Water Fitters will be held in Chicago, June 3-5, 1918. Headquarters will be at the Hotel Sherman where the association met when its convention was last held in Chicago, in 1911. This will be the first gathering of the national association in two years as no convention was held last year.

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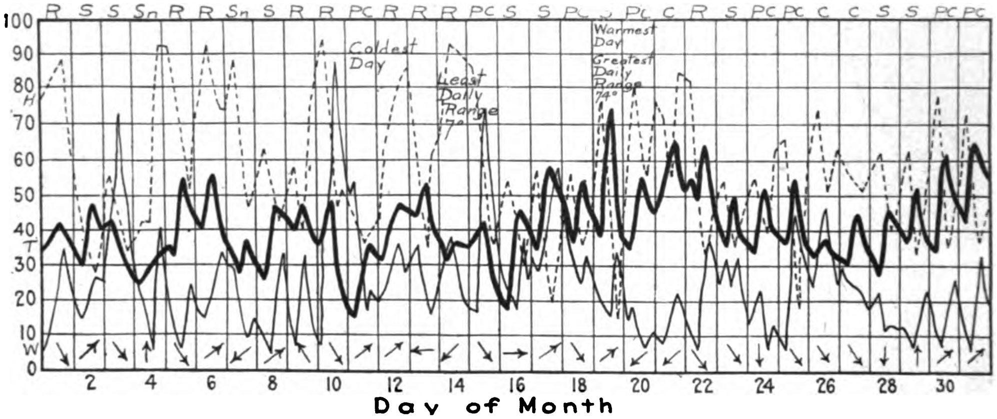
Bureau of Standards Studies Central Station Hot Water Heating.

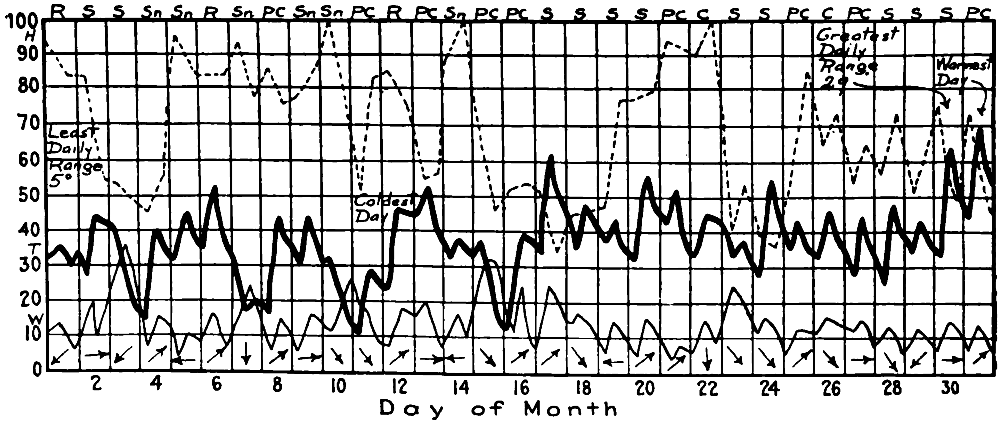
In a report of the activities of the United States Bureau of Standards for the past year, it is stated that the bureau has made studies of central water-heating systems in fifteen cities in the Middle West, for the purpose of formulating technical standards of service for such central heating systems. The work is carried on in close coöperation with the engineers of the Indiana Public Service Commission and with the educational committee of the National District Heating Association. The results will be embodied in a circular entitled "Standards of Service for Central Heating Plants," similar to the circulars already published by the Bureau of Standards on "Standards of Gas Service" and "Standards for Electric Service."

The Weather for March, 1918

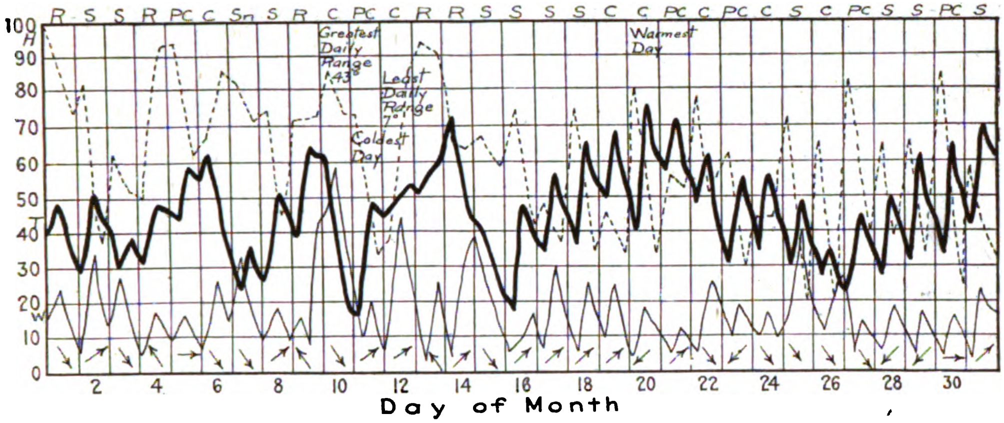
	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest temperature, degrees F	74	69	75	74	84
Date of highest temperature	19	31	20	21	13
Lowest temperature, degrees F	16	11	17	18	22
Date of lowest temperature	11	11	11	10	10
Greatest daily range, degrees F	35	29	43	40	49
Date of greatest daily range	19	30	10	9	9
Least daily range, degrees F	7	5	7	5	7
Date of least daily range	14	1	12	13	23
Normal temperatur for month, degrees F	41.2	37	45	42.2	52.6
Mean. normal mean temp. for month, deg. F	37.5	35	39.5	34.4	43.5
Total rainfall, in	1.51	3.19	1.25	2.05	0.67
Total snowfall, in	0.6	12.8	0.5	1.4	——
Normal precipitation, this month, in	4.1	4.08	3.01	2.55	3.43
Total wind movement, miles	14932	8484	9148	9361	10912
Average hourly wind velocity, miles	20.1	11.4	12.3	12.6	14.7
Prevailing direction of wind	N. W.	S. W.	N. W.	S. W.	S. W.
Number of clear days	9	12	11	13	15
Number of partly cloudy days	11	10	6	11	11
Number of cloudy days	11	9	14	7	5
Number of days on which rain fell	9	3	5	8	4
Number of days on which snow fell	2	6	1	3	——
Snow on ground at end of month, in	None	None	None	None	None



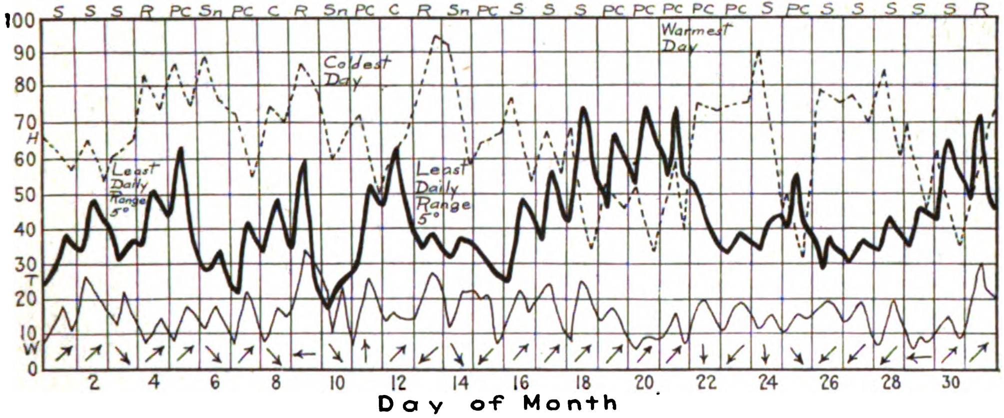
RECORD OF THE WEATHER IN NEW YORK FOR MARCH, 1918.
(Hourly Observations of the Relative Humidity are Recorded on this Chart.)



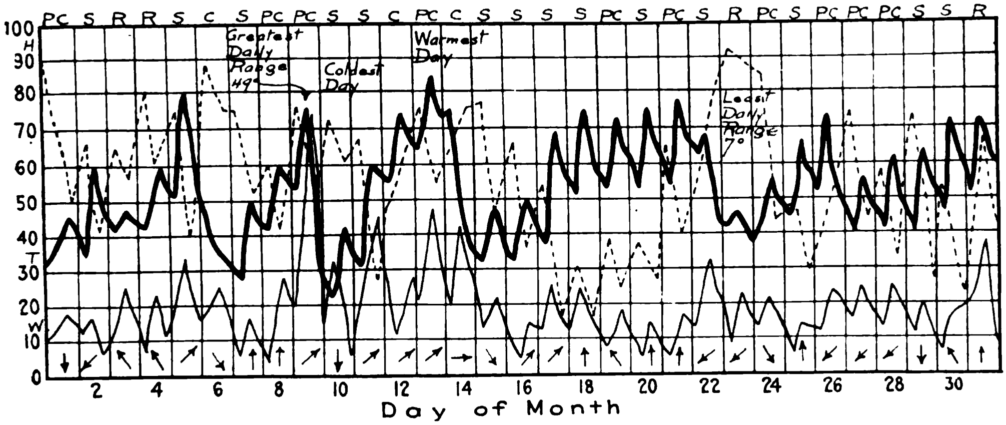
RECORD OF THE WEATHER IN BOSTON FOR MARCH, 1918



RECORD OF THE WEATHER IN PITTSBURGH FOR MARCH, 1918.



RECORD OF THE WEATHER IN CHICAGO FOR MARCH, 1918.



RECORD OF THE WEATHER IN ST. LOUIS FOR MARCH, 1918.

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.

Heavy lines indicate temperature in degrees F.

Light lines indicate wind in miles per hour.

Broken lines indicate relative humidity in percentage from readings taken at 8 A. M. and 8 P. M.

S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.

Arrows fly with prevailing direction of wind.

The War and the Heating Engineer

Call for Trained Men by Bureau of Mines.

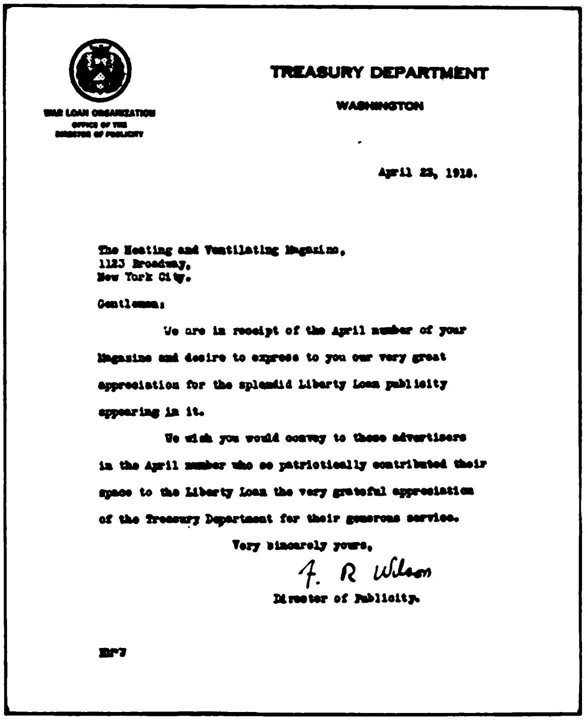
Important chemical and other technical engineering work necessary for the prosecution of the war is being carried on by the Bureau of Mines Experiment Station, at Washington, D. C. The services of trained men of the following classifications are urgently needed:

- Bacteriologists
- Biologists
- Chemists, Inorganic
- Chemists, Organic
- Chemists, Physical
- Chemists, Electro-
- Chemical Engineers
- Draftsmen
- Electrical Engineers
- Instrument Makers
- Laboratory Assistants
- Laborers
- Machinists
- Physiologists
- Plumbers
- Steamfitters
- Stenographers
- Skilled labor of various kinds.

If your training fits you for any of these occupations, send to the Bureau of Mines, American University Experiment Station, Washington, D. C., for blank forms. When properly executed and returned by you, these forms will be placed on file, and when a vacancy occurs you will be considered for it and will be notified if your services are desired.

If you are a registrant in the draft, and have not yet been ordered to camp, it may be possible to have you immediately inducted into the service for work here.

If you are *not* in the draft, but feel that you wish to serve your country in the present crisis, you can enlist, or serve as a civilian.



WAR LOAN ORGANIZATION
OFFICE OF THE
DIRECTOR OF PUBLICITY

TREASURY DEPARTMENT
WASHINGTON

April 23, 1918.

The Heating and Ventilating Magazine,
1123 Broadway,
New York City.

Gentlemen:

We are in receipt of the April number of your Magazine and desire to express to you our very great appreciation for the splendid Liberty Loan publicity appearing in it.

We wish you would convey to those advertisers in the April number who so patriotically contributed their space to the Liberty Loan the very grateful appreciation of the Treasury Department for their generous service.

Very sincerely yours,

F. R. Wilson
Director of Publicity.

[illegible]

MESSAGE OF APPRECIATION FROM TREASURY DEPARTMENT.

Thrift Banks to Aid War Savings.

A thrift bank designed to sell United States thrift stamps automatically has been adopted by the National War Saving Committee. Thrift banks it is stated, will soon be found wherever thrift stamps are sold by authorized agents.

President Urges Preparation in Engineering.

Acting on resolutions submitted by a committee headed by Dean M. E. Cooley of the College of Engineering, University of Michigan, President Wilson has written a personal letter, which appears in the *Michigan Technic* for March, urging preparation in engineering as a means to help fight the war and to help the reconstruction after the war. Dean Cooley states that the attendance in engineering since this country entered the war has fallen off from 25% to 35%. Hardly a day passes without calls from the army or navy for the university's more advanced students. As a result the graduating classes this year will not be more than half their usual size. The Engineer Enlisted Reserve Corps and the Naval Reserve Force, now that they have been established, will no doubt keep in college many who would otherwise go. At the University of Michigan there are between 250 and 300 upper classmen in these reserves, but even that is a small percentage of the usual attendance of 1400 or 1500.

Ordnance Department Still Calling for Inspectors and Engineers of Tests.

Among the urgent needs of the Ordnance Department in the way of inspectors and engineers of tests, the following are given special prominence:

Engineers of tests of ordnance material, inspectors of artillery ammunition, metallurgical chemists, assistant inspectors of cannon (forging operations), assistant inspectors of gun carriages and of gun carriage parts, assistant inspectors of gunfire control instruments, assistant inspectors of motor vehicles, and assistant inspectors of artillery wheels. A list given of plants within a radius of 50 miles of New York City, furnishing artillery ammunition materials for the Ordnance Department, contains no less than 116 such plants.

All of the positions mentioned are under the civil service.

Progress of War-Savings Campaign.

The receipts of the Treasury Department through the sale of War-Savings and Thrift Stamps through February, have equalled $75,000,000. The receipts for the month of February totalled $41,000,000, as against $37,000,000 received through the War-Savings campaign in England for the same period, despite the fact that the campaign has been running there for over two years.

The receipts are coming in to the Treasury Department at the rate of about $2,000,000 a day. In other words, the receipts in this country, after three months, are already running at the same rate which England has reached after two years.

The total receipts in England up to January 26, 1918, were $550,000,000. At the rate at which the campaign is running here, we shall reach this total inside of the year allowed by Congress for the present campaign. If the rate continues to increase as it has been increasing during the past month, there should be no difficulty in attaining the $2,000,000,000 goal set by Congress for the year's campaign.

If the campaign attains the goal set, it will cover the entire cost of the government's ship building programme for the year. Already the government is receiving from the buyers of War-Savings Stamps daily, enough money to build more than 10,000 tons of shipping. It has received, to date, funds for the building of 420,000 tons or 84 ships of 5,000 tons each.

Are You Going or Coming?

Under the heading of "Are You Going or Coming?" what are described as "a few pointed questions," are addressed to American business men by W. M. Hart, advertising manager of *Photoplay*, the matter occupying a full page in the *Chicago Tribune*.

Some of Mr. Hart's points are:

Did you think that you could ***embalm*** your business for the period of the war and then resuscitate it at will? It can't be done.

You cannot wait until after the war to join this select coterie of the men who carried on. You will have to do it ***now.*** There is no cure for arrested development.

How long do you think your good-will is good for, anyway, if left to itself—even in normal times?

You cannot starve your business and make it win. But you can cut out the frills and ***give it nourishment!***

The United States is not going to quit—why should you?

Heating Men in Military Service.

Major J. W. H. Myrick, of the Autoforce Ventilating System, Boston, announces that he has a service flag spread to the breeze at his residence on account of the enlistment of Mrs. Myrick as yeoman in the United States Naval Reserve Force. Mrs. Myrick successfully passed the civil service examination and is stationed at the Boston Navy Yard on special duty.

Sergeant C. T. Sedden, formerly business manager of the Wm. H. Seden Plumbing & Heating Co., Columbus, O., who enlisted in the cavalry for border service, has been transferred to the heavy artillery and is stationed at Camp Stanley, Leon Springs, Texas.

First Lieutenant Wallace J. Pattison, U. S. R. Engineers, a nephew of Major W. M. Pattison, President of the W. M. Pattison Supply Co., Cleveland, O., was one of the survivors of the transport Tuscania, which was torpedoed and sunk off the Irish coast recently.

D. P. Carter, of Kingston, Pa., has received a commission as lieutenant and has been detailed to the Gunpowder Reservation, in Baltimore.

Oliver E. Willis, formerly with the Vapor Heating Co., New York, has been commissioned first lieutenant in the Ordnance Reserve Corps and has been assigned to active duty with the American Ordnance Base Depot in France.

Theodore W. Little, vice-president of the Walworth Mfg. Co., Boston, Mass., has joined the government forces in Washington where he is responsible for the proper distribution of the mill production in textile materials to the various quartermasters' depots throughout the country.

Camp Utilities Department to Handle Mechanical Equipment.

A utilities department has been established at Camp Grant, Rockford, Ill., to take care of the proper lighting, heating, water supply and ventilation in the camp. The department is made up of 350 enlisted men, with Major Paul Doty in charge of the department.

New York Merchants' Association Establishes Industrial Bureau.

A service to keep manufacturers informed of all government regulations affecting industry, as well as the methods employed by manufacturers to meet the numerous war problems, has been established by the Merchants' Association of New York, and will be known as the Industrial Bureau of the Merchants' Association. It is stated that the bureau will be glad to give information and assistance to manufacturers at any time.

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Current Heating and Ventilating Literature.

Under this heading is published each month an index to the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the article mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

EVAPORATION

Some General Aspects of Evaporation and Drying. Hugh K. Moore. 4500 w. Met & Chem Eng—Feb. 1, 1918. Serial, 1st part. General theory and practice. 60c.

FUEL SAVING

Fuel Saving in Household Heating. Robert E. Dillon. Ills. 3000 w. Gen Elec Rev—Feb., 1918. Urges efficient management of domestic heating plants. 40c.

CORRESPONDENCE

Suggestions for Research Laboratory in Heating and Ventilation.

EDITOR HEATING AND VENTILATING MAGAZINE:

Realizing the fact that our country at the present moment is engaged in a gigantic task of world-wide importance, appreciating that it requires the sincere and efficient co-operation of all bodies that are in a position to aid the national endeavor, and feeling certain that The American Society of Heating and Ventilating Engineers, as a body, has the will and power to help very materially in the good cause, I will look at the subject of suggestions for laboratory research simply from the national service point of view. I think this is the way the society should look at its proposed research bureau just now.

After the war is over there will be plenty of time and opportunity to investigate along lines of association, or trade, service. Therefore, I would suggest that the first step be an offer of the laboratory service to the United States government for investigations along any specific lines of heat generation, manipulation, utilization, or conservation, as may be desired by the government during the period of the war. If the government cannot use the laboratory advantageously at present, I think it should co-operate with the government as much as possible so that no conflict of opinion may ensue.

Fuel conservation is, presumably, the first and most important problem for investigation. This subject may be divided as follows:

1. Determination of more economical ways to burn both bituminous and anthracite coals so that more heat will become available for useful service.
2. Determination of more efficient means for harnessing the heat given off by the fuel so that less heat will be lost up the chimney and elsewhere.
3. Determination of more effective means or methods for transmitting, with the least possible loss, heat from its source of generation to its destination for utilization.
4. Determination of the most effective means and methods of utilizing heat in an economical way without detriment or injury to health, working capacity, business efficiency or morale of the public.
5. Determination of means of avoiding undue heat loss from buildings of different kinds, and the simple repairs or changes so

essential in many buildings to prevent unnecessary heat loss.

6. Determination of prompt and effective publicity of the information obtained so that the public will be enlightened and millions of coal users put in a position to burn fuel and use its heat in a more economical manner than exists at present.

I do not think the society should cause any research to be made, at this time, along any lines that do not tend to help the government and nation in the present crisis.

Service to the nation is the first call. Service to ourselves as individuals should come after the future security of the nation has been firmly established.

Scranton, Pa. T. N. T.

Three-Store Heating Problem.

EDITOR HEATING AND VENTILATING MAGAZINE:

We enclose you a sketch of three store buildings in the center of a block which have no exposure but front and back. It has been hard to determine exactly how much heating surface is necessary to put in buildings of this class. If you figure the whole surface as exposed, that is, all of it, you usually get entirely too much heating surface. What I wish to know is the safe way of figuring radiation in this class of buildings. You can assume that these buildings have basements underneath and are one or two stories high, as will suit your convenience. Also you can assume the width and length of the building, thickness of the walls, and the glass. I do not see anything in your Data Sheets, or information that has been running through the magazine this past year, that gives any information on buildings situated as these are.

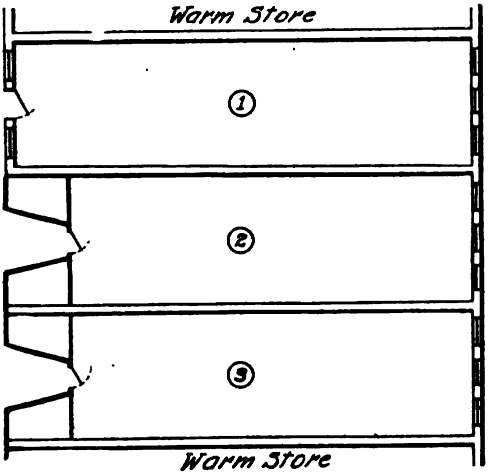

FIG. 1.—PLAN OF THREE-STORE BUILDING SUBMITTED BY CORRESPONDENT.

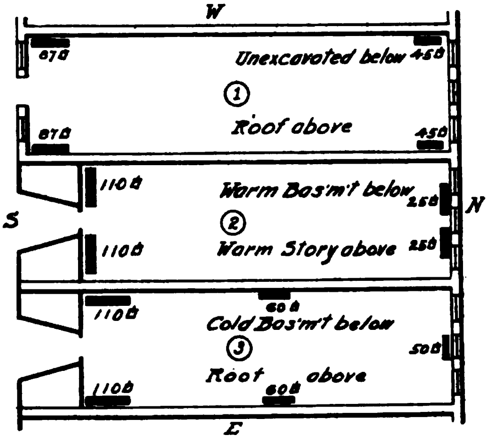

FIG. 2.—ONE METHOD OF HEATING THREE-STORE BUILDING.

This comes up quite frequently, and there seems to be quite a variation in the amount of radiation figured.

Louisville, Ky. W. C. G. & Co.

Our correspondent's question is one which often puzzles heating men and many good engineers have varying opinions as to how such a proposition should be figured. The sketch as submitted by our reader is shown in Fig. 1 and consists of three stores Nos. 1, 2 and 3, No. 1 having a straight front and Nos. 2 and 3 having set-in vestibules and show-windows of plate glass. The rear wall of each store has three windows and Nos. 1 and 3 have warm stores next to them so that the only exposure is at the front and back.

Our correspondent desires us to figure the radiation for these stores, making our own assumption as to walls, basements, etc. Suppose Store No. 1 has a concrete floor laid on dirt and a plaster ceiling forming a furred-in space immediately below the roof; i. e., No. 1 is a one-story proposition without basement. No. 2, let us assume, is a two-story and basement store, with heat in the basement and story above. No. 3, we will suppose, is similar to No. 1, except that it has a cold basement beneath. Buildings face south, outside temperature—10°, inside temperature 60°; height, 13 ft.; length of stores 58 ft.; width 16 ft.; area of glass, transom and door in front of No. 1, 57 sq. ft.; in rear 45 sq. ft.; area of glass and door in front of Nos. 2 and 3, 308 sq. ft.; in rear, 45 sq. ft.

TO COMPUTE NO. 1:
Front Wall, 12-in. brick.
16 × 13 = 208 sq. ft.
Glass 57 " "

Net Wall 151 " "
B. T. U. for front wall.
60°
—10°

70° temp. diff. glass = 70 (See Standard Data Sheet 1-F)
12-in. brick = 16.1 (See Standard Data Sheet 1-A)

Glass
57 × 70 = 3990 B. T. U.
Wall
151 × 16.1 = 2431 B. T. U.
Leakage 20 ft.
back from wall
one air change:
16 × 13 × 20 = 4160 cu. ft. times factor of 1.27 (See Standard Data Sheet No. 3)
4160 × 1.27 = 5283 B. T. U.

11704 B. T. U. for front wall.

Rear Wall
Total wall:
16 × 13 = 208 sq. ft.
Glass = 45 " "

Net wall 163 " "
B. T. U. Glass 45 × 70 = 3150
B. T. U. Wall 163 × 16.1 = 2744
Leakage 20 ft. back =
16 × 13 × 20 = 4160 cu. ft.
4160 × 1.27 = 5283

11177 B. T. U.
Increase for north exposure,
15% 1676

12853 B. T. U.
total for rear wall.

The roof space (assuming 35° as the lowest temperature and lath and plaster ceiling) has a factor of 21.7 (See Standard Data Sheet No. 1-G) and the total ceiling loss is 16 × 58 × 21.7 = 20137.6 B. T. U.
Placing half of this ceiling loss on the *front* wall gives 11704 + 20137/2 =
11704 + 10069 = 21773 B.T.U.
and for the *rear* wall
12853 + 10069 = 22922 B. T. U.
This gives for the front 21773 ÷ 250 = 87 sq. ft. Doubling for being near door (See Standard Data Sheet No. 13) gives two radiators each of 87 sq. ft. at the front of the store and for the rear 22922 ÷ 250 = 91 sq. ft. or two radiators each of 45 sq. ft. at rear of store.

STORE NO. 2
Front wall
28 × 13 = 364 sq. ft.
Glass 28 × 11 = 308 sq. ft.

Net wall 56 sq. ft.
308 × 70 = 21560 B. T. U.
56 × 16.1 = 902 B. T. U.

Total = 22462 B. T. U.
one air change
20 ft. back
same as No. 1 = 5283 B. T. U.

Total B. T. U. = 27745 for front wall.
Rear wall.
Same as No. 1 or 12853 B. T. U.

This store having a warm ceiling and floor no further additions are required so that the surface at the front will be 27745/250 = 111 sq. ft. and doubling for door gives two radiators of 110 sq.ft. each.

For the rear wall there will be 12853/250 = 51 sq. ft. needed or two radiators of 25 sq. ft. each.

FOR STORE NO. 3
Front wall
B. T. U. loss same as No. 2 27745 B. T. U.
Rear wall
B. T. U. loss same as No. 2 12853 B. T. U.
Ceiling loss same as No. 1 20137 B. T. U.
Floor loss—say ordinary double thick flooring without lath or plaster factor for 35° (See Standard Data Sheet No. 1-G) 10.8
16 × 58 × 10.8.......... 10022 B. T. U.
Total loss for front of store is
27745 for wall and glass
10069 for one-half of ceiling
5011 for one half of floor.

42825 B. T. U. ÷ 250 = 171 sq. ft. for front.
Total loss for rear is
12853 for wall and glass
10069 for one-half of ceiling
5011 for one-half of floor

27933 B. T. U. ÷ 250 = 111 sq. ft. for rear.

Doubling the front radiators for door makes too large units to be desirable so that it will give better sizing to put the radiation for the front wall, glass and leakage in the front, the radiation for the rear wall, glass and leakage in the rear and to provide two intermediate radiators to care for the floor and ceiling located in the middle of the store. This gives distribution as follows:
Front wall losses:
27745 B. T. U. ÷ 250 = 111, or two radiators of 110 sq. ft. each after doubling for door.

Rear wall losses:
12853 B. T. U. ÷ 250 = 51 sq. ft.
Floor and ceiling losses:
20137 B. T. U.
10022 B. T. U.

30159 ÷ 250 = 120 sq. ft. in middle of store, or two radiators of 60 sq. ft. each.

Our correspondent's question doubtless relates to the amount of leakage to allow for in large spaces of small exposure. This is a subject on which engineers will differ, but 20 ft. back from the exposed wall is entirely sufficient to cover all ordinary needs. This is based on the fact that in an ordinary room one air change an hour is entirely sufficient for ordinary cases and the average room is very seldom over 20 ft. deep.

On the other hand, if it is desired to warm up the air in a room in a given length of time the heat required for the whole cubic contents must be considered. It is the custom of one engineer when putting in radiators for interior corridors in schools, where there is *no exposure* whatsoever, to put in a radiator sized for one air change per hour so as to heat up these corridors in the morning after they have cooled down over night.

Proper Connections for Pipe Coils.

Editor Heating and Ventilating Magazine:

Referring to the article in your March number on "Meeting the High Cost of Heating and Ventilating Apparatus," I offer the following suggestions:

When I commenced business about forty years ago, we used pipe coils almost exclusively except for residences. For circulating coils under 40 ft. long, mitre coils and bracket coils, we fed and returned through a single pipe. The mitre coil, Fig. 1 shown on page 15 could be simplified by using a single connection at the bottom of return tee, doing away with a lot of pipe connections and check valves. I think the mitre coil as shown would get air bound the way you show it. The supply should be in center of branch tee instead of the end and the air valve in top of the return tee.

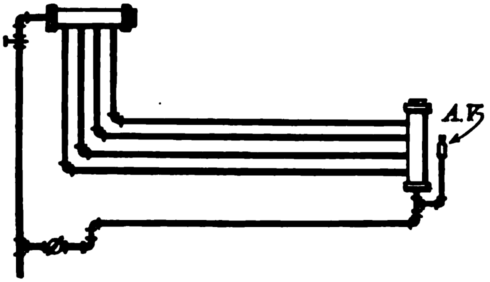

FIG. 1—COIL CRITICISED BY CORRESPONDENT.

The return bend or bracket coil, Fig. 2, should be fed at the bottom and return through same pipe and the air valve placed at the top.

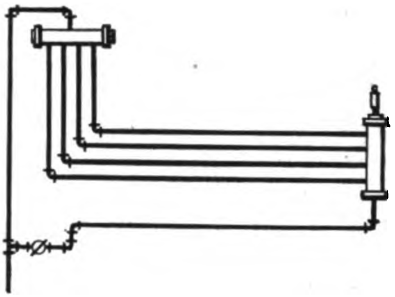

FIG. 1-A.—COIL AS REVISED BY CORRESPONDENT.

We once did a school job, using circulating coils under windows 40 ft. long and indirect box coils 10 pipes high, 4 ft. long, all fed and returned through a single pipe and no returns on the job except at the end of the main supplies in basement. The circulation was perfect. I still have the plans of this job on file.

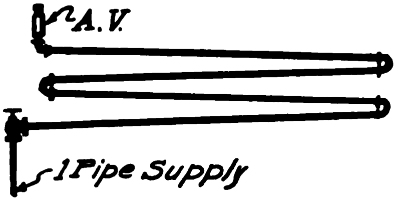

FIG. 2-A.—RETURN BEND COIL AS ADVOCATED BY CORRESPONDENT.

Chicago. L. H. P.

The method of coil connection objected to by our correspondent—who, by his letterhead, is the president of an old firm of heating, ventilating and power plant contractors established since 1877—is shown in Fig. 1 and the proposed change in Fig. 1-A. Owing to our reader's long experience and responsible position we have considered his suggestions most carefully and checked up his scheme with several other authorities, beside the author of the article in question.

We find in Harding and Willard's new reference work on "Heating and Ventilation" p. 96, an illustration of a typical miter wall coil and the pipe connections thereto. This coil is fed from the end of the top manifold just as originally shown in our article and the air valve is indicated in two positions—one on the top of the return manifold (as advocated by our correspondent) and the other near the bottom of the return manifold (or very close to the point where it was located in the article).

"Modern Engineering Practice," a work of twelve volumes compiled by the American School of Correspondence, gives on p. 62 of Vol. XII a view of a typical miter coil. They also follow the idea of feeding the top manifold at the end and of locating the air valve just above the bottom of the return manifold.

Other authorities show similar connections. In only a very few instances is a manifold with a back outlet even considered and we have seen hundreds of walls coils connected up on the supply end as illustrated in the original article. and they were giving perfect satisfaction. Therefore, while we are inclined to believe that our correspondent's scheme of feeding is perfectly feasible, we cannot admit that the method of feeding shown in the original article is out of line with the very best practice; it certainly shows no indications of any liability to give trouble in operation.

Our correspondent also says he believes a coil so connected would air bind. The only way air binding can be obtained in a coil is by the steam travelling through one or more lines of pipe, reaching the return manifold in advance of the steam traveling by other routes and closing the air valve before the air in the slower operating pipes is expelled. If our correspondent will compare carefully the length of steam travel on the coil originally illustrated he will find that the steam travel from the point where it enters the supply manifold to the point where it leaves the return manifold is *exactly the same length* no matter which pipe is considered, the shorter pipes of the coil requiring the steam to pass through the entire length of both supply and return manifolds. Thus a much more even travel of steam down *all* the pipes toward the air valve is assured and if this travel is at an exactly equal rate all the pipes will be completely rid of air and filled with steam during the same interval of time, thus insuring that at the time the steam reaches the air valve all pipes of the coil are freed of air and properly filled with steam.

With the correspondent's scheme of center feeding at the supply manifold as herein illustrated we believe there would be a great tendency of the entering steam to drive down the middle pipes of the coil due to its entering velocity. While this might not be sufficient to cause serious trouble the tendency would be to heat these pipes first and to shut the air valve before the top and bottom pipes of the coil are blown out.

The only other way steam could get to the air valve, of course, is through the drip connection of the coil and this is exactly the reason of inserting the check at that point so that under no possibility could the coil feed through both pipes or "back-fire" so as to close off the air valve before being fully blown out.

The location of the air valve on the *top* of the return manifold we regard as wrong fundamentally owing to the steam vapor being lighter than the air and always seeking the higher portions of the radiating surface. No one would think of putting an automatic air valve on a radiator at the top for this very reason and we do not believe it is generally considered good practice on coils. On the other hand, the tendency to air bind the coil by locating the air valve in this position may not be serious enough to cause unsatisfactory results; the air valve is most efficient when kept as low as possible.

The return bend coil (originally illustrated in Fig. 2, p. 16, of March issue) as proposed by correspondent, is shown in Fig. 2A and consists of a regular return bend coil supplied at the bottom by a one-pipe steam connection and terminating at the top end in an elbow on top of which is set an automatic air valve. There is no question but that a coil so connected would operate but how satisfactorily is problematical. We are unable to locate any authority who *advocates* such a connection and most heating engineers fight shy of one-pipe coils with manifolds to say nothing of one-pipe return-bend coils. The long travel that the ever increasing quantity of condensation must negotiate before getting out of the small pipe of the coil and into the larger main including pouring down through return bends *against* the flow of steam instead of *with it* makes us very dubious as to this arrangement for general work.

It would be very easy to get a coil wherein the pipe near the bottom would not have sufficient area to permit easy and noiseless passage of the returns flowing back against the steam. For this reason we are of the opinion that while the coil shown in Fig. 2-A, with careful design, could be made to work in a reasonably efficient manner, the flow of the condensation in the coil should be *with* and not *against* the flow of steam. Such a result is obtained with the original Fig. 2, but not with correspondent's suggested Fig. 2-A.

Comparative Cost of Pipe Coils and Radiators.

EDITOR HEATING AND VENTILATING MAGAZINE:

I note with interest in your March, 1918, issue an artcle on "Meeting the High Cost of Heating and Ventilating Apparatus," in which it is suggested that pipe coils be used instead of radiators.

As contractors, we believe that this is misleading and confusing to the public, taking into consideration the cost of steamfitters' and steamfitters' helpers' wages, the cost of cutting and threading the pipe and the cost of raw pipe itself, and taking into consideration the use of hook plates, screws, manifold headers and the cost of two valves on a supposed one-pipe unit; it is demoralizing in the extreme.

New York City. J. C. W.

We are not quite clear as to just what our correspondent means unless it is that he wants to assert that pipe coils are more expensive to install than direct cast-iron radiation to give equal heating effect. If this is his position we hardly feel that we can agree with him. Of course there is a time, however, when the size of the heating units gets down to such small limits that it would cost more to make up a coil than it would to use a small radiator.

With the unsettled conditions in the labor market at present, it is hard to make a comparison that would be applicable to all parts of the country, but it must be universally recognized that coils were cheaper to use under pre-war conditions as their constant employment in all places where cost superseded appearances amply testifies.

Coils are used almost exclusively in large garages, factories, manufacturing plants, school basements, etc. It is also a well-known fact that cast-iron radiation has increased in cost nearly 150% since the beginning of the war. Therefore, unless steamfitters' wages, the cost of black iron pipe and fittings, hook plates and all the other parts used in coil work have each and every one increased in like proportion the cost of coil work would remain relatively cheaper. We do not believe that on the average such large increases in wages and the cost of pipe, etc., have taken place and, therefore, it hardly seems reasonable to suppose that the pipe coil in large installations will cost relatively more under present conditions than it did formerly. On the contrary, present indications seem to point toward making a greater saving under present conditions than formerly. We should be glad to hear from other contractors in regard to their ideas on this matter.

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Novel Method of Enclosing Radiators

EDITOR HEATING AND VENTILATING MAGAZINE:

The January number of THE HEATING AND VENTILATING MAGAZINE duly reached my table and as I have been interested in gathering data on heating standards I turned to examine your latest data sheets. On No. 13 under "Computing Radiation" the statement is made that "Radiators installed so that the air does not circulate freely around them suffer a loss of efficiency and must be increased as follows: Recessed radiators 20%, and concealed radiators 40%."

This agrees with all other data and information I have been able to obtain from text-books and journals and records of tests.

As, perhaps, you know, in a residence it is a great objection to have the radiators exposed as they will cause the dust to blacken the walls and if the radiator is placed under a window it will soon soil the curtains and hangings. About six years or more ago, I designed an enclosure for concealing the radiator under the window, which allowed the air to circulate freely and therefore did not lose in efficiency over a free standing radiator. It also had the effect of so protecting the curtains and drapery that they were not affected in the usual way, with the accumulation of dust. I have been using this method of enclosing for the last six years and have never allowed anything for decreased efficiency but have figured my heat losses and proportioned my radiation to offset the heat losses as usual. I compute my heat losses by Carpenter's rule, using such co-efficients for B.T.U. as in my opinion suit materials used in the construction.

This method of enclosing radiators may be of more interest to the architect than to the heating engineer as it provides a method of attractively installing radiators which the usual heating engineer considers outside of his province.

I enclose a diagram showing the method of enclosing a radiator under a window and under a window seat. Both the window seat and the sill proper remain perfectly cool, and the fact that during the present extreme winter all of my heating systems installed in this way have kept the houses warmed, makes me believe, in view of other tests, that a radiator so enclosed is fully 100% efficient. I think the diagram is self-explanatory, showing the radiator in the usual enclosure with a grille on top through the window sill and one on the face, with the addition of a deflector of sheet metal fastened to the sill as shown and extending over and down about two-thirds at the back of the radiator. This will cause the cold air from the window to drop through the upper grille down back of the radiator, then up through, similar to an indirect radiator, which acts to induce a current of air along the lines of the arrow. The other diagram shows the same arrangement applied to the window seat. Both the window seat, the back and sills remain cool and there appears to be no uncomfortable draft from the window sill, as the air all seems to be drawn down through the grille. This method of installing has been recently adopted by some of the engineers in Detroit with the same success as I have had.

This same scheme worked equally well in sun porches.

Saginaw, Mich. J. F. B.

Our correspondent has submitted a suggestion which should prove of considerable benefit to our readers. Many cases are met with in regular heating work where concealment of the radiator is desirable and this is usually accomplished only with some loss of efficiency. A careful consideration of the method of installing used by the correspondent (as illustrated in the plan and elevation shown in Fig. 1) shows that this scheme should produce very good results,—in fact, much better than the common concealed radiator—for the following reasons:

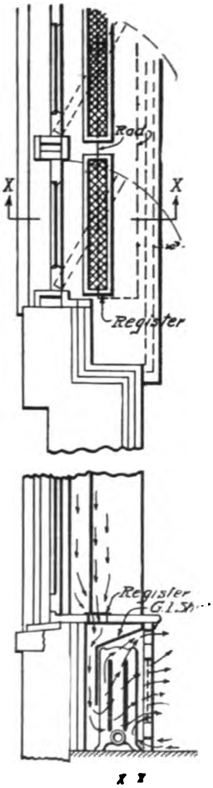


FIG. 1.—CORRESPONDENT'S METHOD OF ENCLOSING RADIATORS.

First, the natural tendency of the cold air against the window glass to drop is in this case taken advantage of and facilitated by the radiator action, instead of being counteracted by the upward hot air flow from the radiator.

Second, the air thus striking the radiator direct from the cooling surface of the window is likely to be much cooler in temperature than air circulating around the floor of the room from which the ordinary radiator draws its supply.

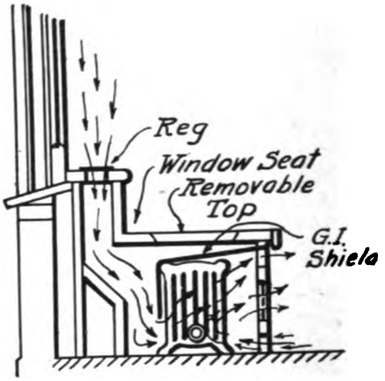


FIG. 2.—CORRESPONDENT'S METHOD OF INSTALLING RADIATOR UNDER WINDOW SEAT.

Where a small window radiator is used with a low seat the seat is provided with a flush cover arranged as shown in Fig. 2. The same theory of operation follows here as in the first case illustrated and the results attained are about the same. Whether or not the correspondent does obtain an equal efficiency with radiators so placed, when compared with those standing out in the open, is doubtful. The fact that without extra allowance these radiators heat the room might only indicate that the method of figuring used is sufficiently safe to allow a slight reduction in radiator efficiency without causing trouble. A condensation test made of two equal-sized radiators, one set out in the open and the other enclosed as shown could, we believe, show a slightly greater efficiency for the exposed radiator.

We thank our correspondent for submitting this suggestion and believe it is a great improvement over the common method of concealing radiators.

Garage Heating.

EDITOR HEATING AND VENTILATING MAGAZINE:

I wish to thank you for your comments and criticism (in April issue) but regret that I did not use more care in explaining the design.

(1) It is, of course, absolutely necessary to have an air valve on the high part of the circulating loop on the basement ceiling and looking up my copy of the sketch submitted to you I find it so noted, which does away with an air-relief pipe.

The radiation was based on the temperature in the garage of 45° F., which, of course, would have some effect on the speed of the circulation. The most radiation was placed in the ceiling coils and in other jobs of similar nature was placed entirely in the ceiling, with no coils whatever near the floor.

Since reading the April number I have talked with the owner of the above job and he advised me that even during this extreme winter the water pipes had not frozen up in his garage and that he had never up to this time found it necessary to open the main valve, which would have allowed full flow.

I wish to say that in our work we have had less complaint in garage work where the coils are placed near the ceiling than when they are placed on the floor. In fact we have one building in which there is 5000 sq. ft. of floor space, four doors, constantly being opened and closed, in which all of the radiation is hung about 30-in. from the ceiling, which is perhaps the most evenly-warmed garage building in the city. This may be accounted for by the fact that the opening and closing of the doors is constantly circulating the air similar to the shafting in cotton mills which equalizes the heat distribution. In my work I have found it impossible to get radiation near the floor and also at the point of the greatest exposure, which always is the door.

(2) In your heat loss co-efficient (Standard Data Sheet No. 1-G) you have the heat loss co-efficients for concrete with cinder fill. Will you kindly advise me what depth this cinderfill is based on? We have for a long time been trying to get the heat loss co-efficients for cinders, but so far have been unable to get anything definite. Your heat loss co-efficients, being given in connection with concerte, does not help us any, as, for a matter of insulation, we might want to pile the cinders 3 ft. deep.

Saginaw, Mich. J. F. B.

In regard to Question (1) we find that air valves were not shown on the original sketch, but it was evident that they should have to be so placed. While it is entirely likely that heating of a character satisfactory enough for a garage might be obtained by the use of ceiling coils alone we are sure that most of our readers will agree with us in the statement that ceiling radiation is not the most desirable arrangement and if the opening and closing of the doors produces sufficient circulation and mixing (as our correspondent states) then it is fair to assume that when the doors are not being opened the heating will be imperfect to a certain extent.

Of course where the space conditions will not permit the locating of radiation at a lower level, the next best thing must be done but if it is possible to place radiation either on the ceiling or the floor it must be conceded that the surface will be more efficient and the results—under equal conditions—more satisfactory if the floor location is used.

In regard to Question (2) the heat loss for a concrete roof slab with "cinder fill," as called for in Data Sheet No. 1-G, undoubtedly refers to a common 4-in. flat concrete roof slab on which the slope and crickets are formed up by the depositing of cinders or cinder concrete at the high points and grading down from the high points toward the low points where the fill disappears altogether. We do not think that it would prove economical to use a cinder fill "three feet" thick for insulation as the additional load thus thrown on the roof would result in added cost of construction so that a hung ceiling or other lighter expedient would be more economical to accomplish the same result. We know of no tests on cinders which would give factors for a fill of 3 ft.

Luminous Paint Instead of Electricity.

A Boston hotel with a large electrical sign, when compelled to cut off its illumination under the recent Fuel Administration order prohibiting such uses of current, had the sign painted with luminous paint, which is said to be a fairly satisfactory war-time substitute.

Location of Thermostat in Ja-Nar' Radiator Covering.

In describing the method of temperature control secured by the Ja Nar' radiator covering, in THE HEATING AND VENTILATING MAGAZINE for February, 1918, it was stated that "this system makes use of a radiator covering made of pressed steel equipped with louvres which are under the control of a thermostat placed in the room and as near the radiator as may be desired." The word, "thermometer" should have been used in placed of "thermostat."

As was brought out further along in the article, the thermostat itself, which controls the opening and closing of the louvres, is placed directly in the housing and forms an important feature of the completed unit, making the unit complete in itself without necessitating connection to any outside operating agent. The thermostat is placed in the current of the inflowing room air entering at the side of the radiator and, as stated in the article, causes the Sylphon thermostat to travel backward or forward, depending on the temperature, and in so traveling it opens or closes the series of louvres which extend across the face of the covering.

◆

New Type of Multiblade Fan.

To the majority of heating and ventilating engineers and manufacturers of this kind of apparatus, there is, perhaps, no type of fan or blower that has commanded more attention, thought and effort during the past few years, on the part of both engineers and manufacturers, than the multiblade or multivane fan. This fan, it will be recalled, was brought out to meet the demand for a fan that would occupy less space with the same or higher efficiency than the standard steel-plate fan.

It is hardly to be expected that the multivane fan has reached the apex of requirements and efficiency. This is not surprising, however, when it is considered that it required almost a century for engineers and manufacturers to work out and experiment on the proper proportion of wheels for the steel-plate fans before they were brought up to their present state of perfection.

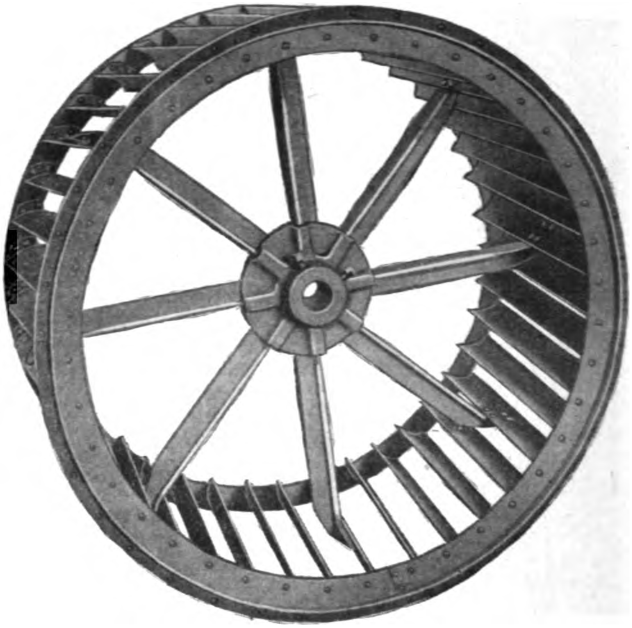
An improved type of multivane fan is now being placed on the market by the Garden City Fan Co., Chicago, which has been perfected, the company states, after long, severe and exhaustive tests under many varied conditions. It is known as the Cycloidal multivane fan. A glance at the illustration will show that the paddles or vanes of the fan are set at an angle (cycloidal) to the shaft, which is their patented feature, and on which the patents have now been issued.

The proper proportion and shape of the vanes have been worked out with great care and, being set at an angle to the shaft, are able to maintain a uniform unrestricted flow of air across the entire width of the wheel. This, it is stated, is necessary to give the maximum efficiency to any multiblade type of fan.

The vanes, in addition to being set cycloidal to the shaft, are curved forward at a predetermined radius to further increase the feed area which makes this new type adaptable to systems where conditions would ordinarily be unfavorable, and where the ordinary multivane fan would not be adaptable.

In mechanical construction, the vanes are rivited to an outer disc which, in turn, is substantially reinforced by angle iron, (in one piece) and the steel spiders which carry the main paddles are cast integral into heavy grey-iron hubs, making it rigid, strong and durable, while at the same time it is somewhat lighter in combined weight than some types of multivane fans, thus decreasing the dead weight friction load on the bearings.

Special care has been taken in the construction of the entire unit to have the fan practically noiseless. Vibration has been eliminated, it is stated, and the manufacturers claim for it the highest efficiency of any multiblade type of fan, while in durability it is rated fully equal to the standard steel-plate fan.


NEW DESIGN OF MULTIBLADE FAN WHEEL

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Trade Literature.

Marsh Gauges, Marsh Automatic Air Valves and Marsh Radiator Traps, are brought to the attention of the trade in a circular issued by Jas. P. Marsh & Co., Chicago, Ill., the full line, as given, including those for each service required in the heating or power plant. This company has a manufacturing record of 52 years, confined to its original patents on gauges, valves and steam specialities. Another circular (No. 34) takes up in detail the Reflux thermostatic traps for use on the return end of radiators or coils of low-pressure, vapor or vacuum systems of heating; also for any two-pipe heating system, gravity or with mechanical suction on the return line.

COMINS ELECTRO PSYCHROMETER, non-battery type, is featured in a recent circular issued by the American Moistening Co., Boston, Mass. This instrument is especially constructed for long, continuous running and operates directly from any electric light or other current. It is provided with a variable current motor. This permits of "plugging in" at fixed stations where relative humidity readings are regularly required at determined places, as in cold storage or other equipments.

DOVE TAIL FLUE VENTS, made of concrete, is an interesting product of the Pacific Coast Concrete Co., Los Angeles, Cal., and described in newly-issued circular matter. The vents are intended for use in connection with gas heaters. They are made in two sizes, with inside dimensions of 2 in. x 4 in. and 2 in. x 6½ in. They are furnished in straight lengths and in elbow form.

MONARCH METAL WEATHER STRIPS are discussed in a well-prepared catalogue issued by the Monarch Metal Weather Strip Co., Louis, Mo., which presents in an interesting manner the constructive features of this kind of weather-stripping and its application to doors and windows of various types. There is, for instance, a special style for casement windows, as well as the regular style for double-hung windows. Detail views show how these strips are applied in each case. Monarch metal weather strips are made of zinc, bronze and copper and are installed, it is stated, only by men trained by experts in the company's factory, and stationed with the different licensees in various parts of the country. Size 8½x 11 in. Pp. 12.

CENTRIFUGAL PUMPS, showing the latest Wheeler designs, are described and illustrated in a new bulletin (No. 108-B) issued by the Wheeler Condenser & Engineering Co., Carteret, N. J.

HOW TO SAVE COAL is the title of a new engineering bulletin (No. 41), issued by the Bailey Meter Co., Boston, Mass. The bulletin starts out with the statement that "to obtain the best results from a boiler plant it is necessary to know the rate of steam generation from each boiler." It is then shown how the Bailey boiler meter accurately records the steam flow on a uniformly-graduated 12-in. circular chart, reading directly in per cent. boiler rating, or, if desired, in thousand pounds per hour or boiler horsepower. The bulletin discusses the matters of boiler efficiency, combustion, air supply, best condition of fuel bed, air as a fuel, how to measure air, effect of coal, etc. The arrangement of the air flow recorder in the Bailey meter is explained at length, as well as the flue gas temperature recorder. The company makes nine different types and classes of boiler meters. Size 8x10½ in. (standard). pp. 20.

CLARAGE KALAMAZOO SECTIONAL DRYING CABINETS are called to the attention of the trade in new circular matter issued by the Clarage Fan Co., Kalamazoo, Mich. The types shown are especially adapted for drying fruits, vegetables or other food products, as well as drugs, chemicals, etc. Details of the dryer are given, including the small multiblade fan used, the steam heater and the cabinet proper, with its stacks of trays. The manufacturers state that they are also prepared to furnish the equipment for larger installations for drying material of any kind. Size 8½ x 11 in. Pp. 4.

STEAM TABLES FOR CONDENSER WORK, fourth edition, has been published by the Wheeler Condenser & Engineering Co., Cartaret, N. J. A complimentary copy, it is stated, will be furnished on request to those in responsible positions who are not yet provided with a copy and who deal with steam and its many problems. Size 4x7 in. Pp. 32.

LITTLE GIANT GAS HEATER is an interesting appliance which could be used as an auxiliary heater for house-heating systems. It is described in circular matter issued by the Little Giant Heater Co., Los Angeles, Calif. As will be noted from the illustration, this heater is intended to be placed underneath the floor of a room, a vent pipe being provided to carry away the products of combustion. It is stated that no gas or fumes can escape into the room as the cast-iron drum of the heater is sealed with asbestos washers and fire cement. It is lighted from a pilot light and operated with a key in the register.

◆

New Publication.

NEW VIEWS OF THE COMBUSTION OF THE VOLATILE IN COAL is the title of Technical Paper 183, recently issued by the Bureau of Mines. It is published under the authorship of S. H. Katz. The paper is one of a series dealing with the volatilization of the hydrocarbons in coal and the burning of the volatile matter in the combustion space of the furnace. The author states that while the reasoning used in the bulletin is necessarily speculative, it is being applied to the study of combustion by the Bureau of Mines.

Has a "Rank Outsider" any License to "Butt In?" is the title of a readable booklet published by H. C. Winchell, advertising specialist, 20 East Jackson Boulevard, Chicago, Ill., which is devoted to the proposition that the outside viewpoint gives the advertising counselor an advantage over the man whose nose is close to his own work.

◆

Heating System for Camp Bowie.

A heating system, to cost $400,000, is being planned for Camp Bowie, at Fort Worth, Texas. It was expected that work would commence on the system before May 1.

◆

Deaths.

William A. Green, vice-president of the F. W. Lamb Co., Chicago, heating contractors, died of heart disease at his home in that city, March 23. He was 69 years old. Mr. Green had been a member of the Lamb Company for over 30 years.

Mrs. John Trainor, of Baltimore, whose husband is a former president of the National Association of Master Plumbers, and who herself was a conspicuous figure at conventions of master plumbers, died in March at her home in Baltimore.

Hugh J. Barron, one of the founders of The American Society of Heating and Ventilating Engineers and, until recent years, prominently identified with that society, died April 6 at his home in New York. Mr. Barron was an Irishman by birth and had all of the proverbial Irishman's wit and spirit. At meetings of the heating engineers' society the members always knew something unusual was coming when Mr. Barron took the floor. His frankness was equally emphatic, whether in criticism or praise. Mr. Barron considered himself a radical and was prone to take the opposite side in a discussion. One of his remembered hits was made at a meeting of heating engineers, when, after he had gone on record as differing pointedly from the view taken by the other speakers, Professor William Kent obtained the floor and said: "Mr. Chairman, I have not always agreed with Mr. Barron, but on the matter under consideration, I am happy to state that we are for once in complete accord." As quick as a flash Mr. Barron spoke up: "Mr. Chairman, then I am undoubtedly wrong!"

Mr. Barron was for practically all his life engaged in the steam fitting business, being for many years a heating contractor in New York. In later years he acted as salesman for manufacturers of heating apparatus. He was 62 years old.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, OF THE HEATING AND VENTILATING MAGAZINE, published monthly at Cooperstown, N. Y., for April 1, 1918.

County of New York, } ss.
State of New York. }

Before me, a notary in and for the State aforesaid, personally appeared A. S. Armagnac, who, having been duly sworn, according to law, deposes and says that he is the Editor of The Heating and Ventilating Magazine, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August, 24, 1912 embodied in Section 443 Postal Laws and Regulations printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:
Publisher, Heating and Ventilating Magazine Co., 1123 Broadway, New York.
Editor, A. S. Armagnac, 1123 Broadway, New York.
Managing Editor, None.
Business Manager, Gustave Petersen, 1123 Broadway, New York.

2. That the owners are. (Give names and addresses of individual owners, or if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent or more of the total amount of stock.)
Heating and Ventilating Magazine Co., 1123 Broadway, New York.
A. S. Armagnac, 1123 Broadway, New York.
Gustave Petersen, 1123 Broadway, New York.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are:
None

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustee, hold stock and securities in a capacity other than that of a bona fide owner and this affiant has no reason to believe that any other person, association or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

A. S. ARMAGNAC, Editor.

Sworn to and subscribed before me this 4th day of April, 1918.

Arnold F. Smith,
Notary Public, Queens County, No. 2073.
Cert. filed in N. Y. County,
County Clerk's No. 575.
N. Y. County Register's No. 9452.
(My term expires March 30, 1919.)

SIZING DUCTS AND FLUES

METHOD NO. 3.

(U. S. Gov.)

The United States Government employs a method based on using the same velocity throughout the ducts, with modifications, reducing velocity beyond the center of distribution and increasing it before the center is reached. This method consists of reducing the size of the fan outlet to an equivalent number of 1-in. pipes and dividing this equivalent number of 1-in. pipes by the amount of air handled per minute; this gives a decimal by means of which the area of any duct is obtained by multiplying the cubic feet of air per minute carried by this decimal.

TABLE 1—CALCULATIONS ACCORDING TO U. S. GOVERNMENT METHOD.

Cubic Feet per Min.	Distance Ft.	Add for Turns Ft.	Equivalent Distance Ft.	Cubic Feet Times Lineal Feet
Two of 1500 ea.	20	—	20	60,000
Two of 1500 ea.	40	—	40	120,000
Two of 1500 ea.	60	—	60	180,000
1500	100	—	100	150,000
1500	120	—	120	180,000
1500	140	—	140	210,000
1500	160	—	160	240,000
Two of 1500	100	50 (a)	150	450,000
Two of 1500	120	50 (a)	170	510,000
Two of 1500	140	50 (a)	190	570,000
				2,670,000

(a) Assumed at 30 in. diameter and 10 diameters for throat radius equal to 1D.

Then multiplying the cubic feet at each outlet by the distance back to the fan, adding the totals and dividing their sum by the total cubic feet of air per minute will give the number of feet to the center of distribution from the fan. One-third of 1% is added for each foot beyond this center and ⅓ of 1% subtracted for each foot less than this center. The velocity in the vertical flues is 600, and 200 ft. per minute through gross area of register face.

Thus, referring to Fig. 1 the outlets starting from the fan are as shown in Table 1.

2,670,000÷24,000=111 ft.

This is so near 110 ft. that 110 ft. may be taken for the sake of even figures. Then corrections on areas will be as shown in Table 2.

TABLE 2—CORRECTIONS ON AREAS.

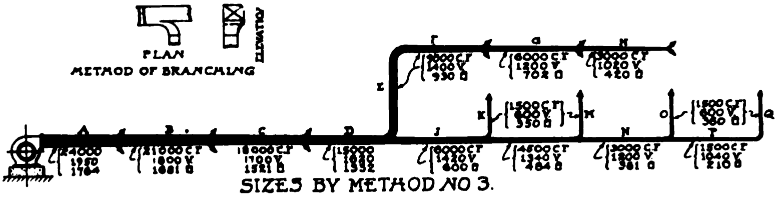
Duct Supplying Outlet or Flue.	Center of Distribution, Ft.	Outlet Distance, Feet	Feet	Correction Factor	Per-Centage
A	110	20	—90	0.0033	—0.30
B	110	40	—70	0.0033	—0.23
C	110	60	—50	0.0033	—0.17
D	110	80	—30	0.0033	—0.10
EF	110	150 (a)	+40	0.0033	+0.13
G	100	170 (a)	+60	0.0033	+0.20
H	110	190 (a)	+80	0.0033	+0.27
J	110	100	—10	0.0033	—0.03
L	110	120	+10	0.0033	+0.03
N	110	140	+30	0.0033	+0.10
P	110	160	+50	0.0033	+0.16

(a) 50 ft. added as equivalent for two 90° bends.

(*Continued on Sheet No.* 10-P.)

SIZING OF DUCTS AND FLUES

METHOD NO. 3 (Con'd)



SIZES BY METHOD NO 3.

To get size of fan discharge and, therefore, the size of duct at the fan the size of fan must be first computed by the formula:

Cubic feet of air per minute $= AD^2N$.
$A = 0.42$ for air washer and ventilation fan.
C. F.M. = 24,000.
Tip speed of steel plate fan with air washer = 4,500.

Outlet at End of Duct	Air for Outlet C. F. M.	Equivalent 1"□ Pipes at Factor 0.476	Correction %	Correction in 1"□ Pipes	Total Pipes for Outlet	Total Pipes for Duct	Size of Duct	Area of Duct Sq. In.
A	3000	1428	-.30	-426	1002	11460	42x42	1764
B	3000	1428	-.23	-328	1100	10458	41x41	1681
C	3000	1428	-.17	-243	1185	9358	39x39	1521
D	No Out	–	–	–	–	8173	36x37	1332
E	No Out	–	–	–	–	5140	30x31	930
F	3000	1428	+.13	+186	1614	5140	30x31	930
G	3000	1428	+.20	+285	1713	3526	26x27	702
H	3000	1428	+.27	+385	1813	1813	20x21	420
J	No Out	–	–	–	–	3033	24x25	600
*K	1500	714	-.03	- 21	693	–	–	360
L	No Out	–	–	–	–	2340	22x22	484
*M	1500	714	+.03	+ 21	735	–	–	360
N	No Out	–	–	–	–	1605	19x19	361
*O	1500	714	+.10	+ 71	785	–	–	360
P	No Out	–	–	–	–	820	14x15	210
*Q	1500	714	+.15	+106	820	–	–	360

*Note.. At 600 velocity or $\frac{1500}{600}$ = 2½□ or 360 sq. in

BASIS OF COMPUTING SIZES OF DUCTS AND FLUES, METHOD NO. 3

Therefore, $\frac{4500}{\pi D} = N$, or

$$\frac{1430}{D} = N.$$

$$\text{C.F.M} = 0.42\ D^2\ \frac{1430}{D} = 0.42$$

$D^2 \times 1430 = 600.60\ D^2$ and

$$D^2 = \frac{\text{C.F.M.}}{600} \text{ or } \frac{24000}{600}$$

$D^2 = 40$ and $D = \sqrt{40} = 6.3$ say 6-ft. wheel, or a 120-in. fan.

A 6-ft. wheel at 4,500 ft. per minute tip velocity equals:

$$6 \times 3.14 \times N = 4500$$
$$18.84\ N = 4500$$
$$N = 4500 \div 18.84 = 238$$

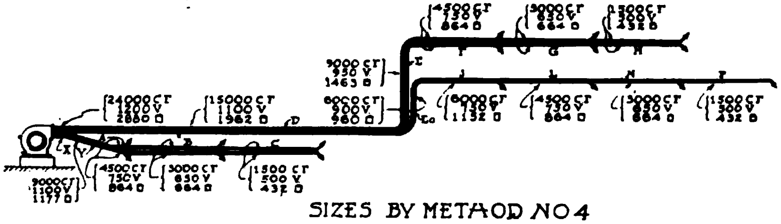
A 72-in steel plate fan wheel has housing 57% of diameter of wheel, or 72 x 0.57 = 41.04 in. say 42-in. housing and 42 in. x 42 in. outlet. Then the duct size at the fan will be 42 in. x 42 in., or equivalent to 11432 1-in. square pipes.

11432 ÷ 24000 = 0.476 factor.

In making branches the practice in this system is to make the branch the full height of the main, regardless of how narrow this makes the branch, put on the elbow, then transform into a circular or square duct as desired. This is illustrated by the detail of branch shown. The basis of computing the sizes of ducts and flues as shown is given herewith and can be readily followed.

SIZING OF DUCTS AND FLUES—METHOD NO. 4

(New York City Board of Education)



SIZES BY METHOD NO 4

Note.—For explanation and example assumed see Standard Data Sheets Nos. 10-M. and 10-N.

In the New York City schools still another method is used. Here the outlets for any one section of a given floor are taken from a duct run horizontally on the ceiling of that floor, the duct being supplied from a main vertical flue, the bottom of which is kept as close to the supply fan as the exigencies will permit. Between the fan and the flues a velocity of 1,000 to 1,200 ft. per minute is maintained and, in the flues, a velocity depending on the height of the flue. The ducts running along the ceilings of the upper floors are arbitrarily graduated from 375 at the farther end up to 750 near the supply flue. In order to supply the sixteen outlets under consideration the duct and flue system would be rearranged as shown so that each floor would be supplied from a horizontal duct located on the ceiling of that particular floor.

The vertical flues are assumed at velocities as follows: 5-story, 1100 F. P. M.; 4-story, 1050 F. P. M.; 3-story, 1000 F. P. M.; 2-story, 950 F. P. M.; 1-story, 900 F. P. M.

SIZING CEILING DUCTS.

Number of Rooms at 1500 cu. ft. each.	Total Cubic Feet per min.	Horizontal Velocity Feet per min.	Area of Duct, Sq. In.
7½	11,250	750	2160
7	10,500	750	2016
6½	9,750	750	1872
6	9,000	750	1728
5½	8,250	750	1584
5	7,500	750	1440
4½	6,750	750	1296
4	6,000	750	1152
3½	5,250	750	1008
3	4,500	750	864
2½	3,750	700	771
2	3,000	650	664
1½	2,250	600	540
1	1,500	500	432
½	750	375	288

Registers at 250 ft. velocity over gross area.
This gives duct and flue sizes about as follows:

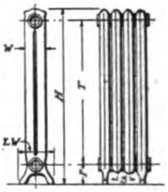
DUCT AND FLUE SIZES

Duct or Flue	Length	Cubic Ft. per Min.	Velocity Feet per Min.	Area Sq. In.
X	Immaterial	24,000	1200	2880
Y	Immaterial	9,000	1100	1177
A	Immaterial	4,500	750	864
Aa	Immaterial	4,500	750	864
B	Immaterial	3,000	650	664
Ba	Immaterial	3,000	650	664
C	Immaterial	1,500	500	432
Ca	Immaterial	1,500	500	432
D	Immaterial	15,000	1100	1962
E	Immaterial	9,000	950	1463
Ea	Immaterial	6,000	900	960
F	Immaterial	4,500	750	864
Fa	Immaterial	4,500	750	864
G	Immaterial	3,000	650	664
Ga	Immaterial	3,000	650	664
H	Immaterial	1,500	500	432
Ha	Immaterial	1,500	500	432
J	Immaterial	6,000	750	1152
L	Immaterial	4,500	750	864
N	Immaterial	3,000	650	664
P	Immaterial	1,500	500	432

The registers are figured at 250 ft. per minute velocity over the gross area and, as wire grilles are used, this is practically 250 ft. per minute across the net area, too. The reason for two ceiling ducts apparently paralleling each other is to prevent the open windows on one side of the building from blowing the air across the duct into the other side. In reality these two ducts consist of a single duct with a middle partition.

H. B. SMITH CO.'S PRINCESS ONE-COLUMN RADIATORS FOR STEAM AND WATER.

Sections	Total Length ft - in.	HEIGHT, INCHES 45	37	31	25	22	19
		5 ft. per sec.	4 ft. per sec.	3½ ft. per sec.	3 ft. per sec	2⅝ ft. per sec	2¼ ft. per sec.
3	0 - 10	15	12	10½	9	7⅞	6¾
4	1 - 1	20	16	14	12	10½	9
5	1 - 4	25	20	17½	15	13⅛	11¼
6	1 - 7	30	24	21	18	15¾	13½
7	1 - 10	35	28	24½	21	18⅜	15¾
8	2 - 1	40	32	28	24	21	18
9	2 - 4	45	36	31½	27	23⅝	20¼
10	2 - 7	50	40	35	30	26¼	22½
11	2 - 10	55	44	38½	33	28⅞	24¾
12	3 - 1	60	48	42	36	31½	27
13	3 - 4	65	52	45½	39	34⅛	29¼
14	3 - 7	70	56	49	42	36¾	31½
15	3 - 10	75	60	52½	45	39⅜	33¾
16	4 - 1	80	64	56	48	42	36
17	4 - 4	85	68	59½	51	44⅝	38¼
18	4 - 7	90	72	63	54	47¼	40½
19	4 - 10	95	76	66½	57	49⅞	42¾
20	5 - 1	100	80	70	60	52½	45
21	5 - 4	105	84	73½	63	55⅛	47¼
22	5 - 7	110	88	77	66	57¾	49½
23	5 - 10	115	92	80½	69	60⅜	51¾
24	6 - 1	120	96	84	72	63	54
25	6 - 4	125	100	87½	75	65⅝	56¼
26	6 - 7	130	104	91	78	68¼	58½
27	6 - 10	135	108	94½	81	70⅞	60¾
28	7 - 1	140	112	98	84	73½	63
29	7 - 4	145	116	101½	87	76⅛	65¼
30	7 - 7	150	120	105	90	78¾	67½



DIMENSIONS

H = Total overall height.
T = C. to C. of tappings.
F = Floor to center of bottom tapping.
W = Width of radiator—7 in.
LW = Width of radiator legs—7 in.
S = Width of radiator sections—3 in.

Nominal Height of Radiator	45-in.	37-in.	31-in.	25-in.	22-in.	19 in.
H	45	37	31	25	22	19
T	38 1/2	29 15/16	24 5/16	18 3/8	15 3/8	12 3/8
F	4 5/8	4 5/8	4 5/8	4 5/8	4 5/8	4 5/8

Push nipple at bottom for steam; push nipple at top and bottom for water.
Length given includes bushings.

Note: For legless radiators deduct 3 in. from H.
For extra high legs add 1 in., 2 in., 3 in., or 4 in., to H. and F.
On all radiators extra high legs are special.

TAPPING DATA

All radiators are tapped 2in. and bushed as follows.

SYSTEM	Size of Radiator Square Feet	Supply In. Diam.	Return In. Diam.
Steam, one-pipe	Up to 30	1	.....
	Over 30 up to 60	1 1/4	.....
	Over 60 up to 120	1 1/2	.....
	Over 120	2	.....
Steam, two-pipe	Up to 50	1	3/4
	Over 50 up to 120	1 1/4	1
	Over 120	1 1/2	1 1/4
Water	Up to 50	1	1
	Over 50 up to 120	1 1/4	1 1/4
	Over 120	1 1/2	1 1/2

All air valve tappings are 1/8 in, those for water radiators being set at top.
All tappings with R. H. threads unless otherwise ordered.

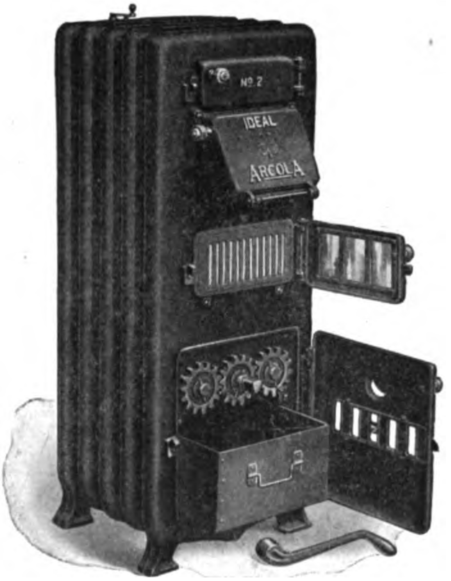
RADIATORS—H. B. SMITH CO.'S ONE-COL. PRINCESS | No. 28-G.

IDEAL Arcola Hot Water Heating Boiler

For cellarless small houses and flats

The heating contractor has in the IDEAL Arcola a most satisfactory solution of the individual heating demands of factory and community housing projects.

In general purpose like a stove, heating the room in which it is placed, but unlike a stove, providing circulating hot water for radiators in adjoining rooms.



The IDEAL Arcola is both a boiler and a radiator. Note the large, slanting fire-door, the cheerful mica door, and the deep, snug-fitting ash pan

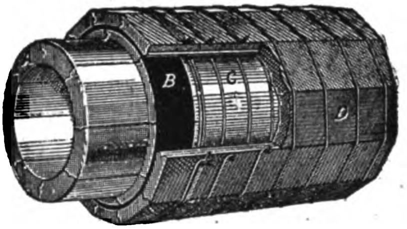
The piping is, of course, ordinarily run out of sight, within walls or partitions.

Great fuel saving, together with the desirable and equitable warmth of Hot Water Heating, is secured.

Write today for special literature illustrating and describing the IDEAL Arcola

AMERICAN RADIATOR COMPANY

Sales branches and showrooms in all the large cities



A—Inner Shell, 2 inches thick.
B—Asphaltum Packing.
C—Dead Air Space.
D—Outer Shell, 1 inch thick.

Cover Your Steam Pipes

WITH WYCKOFF'S IMPROVED

CYPRESS COVERING

Made of Gulf Cypress, the wood eternal

Not affected by wet and dry conditions common to steam-pipe trenches. Will not rot. Lasts twice as long as Pine Casing. Absolutely water and steam tight. Each shell is wound with heavy galvanized wire. Coated all over with the best known preservative—Hydrolene B.

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TRADE AND MISCELLANEOUS NOTES

Coming Events.

June 4-6, 1918.—Annual convention of the National Association of Master Steam and Hot Water Fitters, in Chicago. Headquarters at the Hotel Sherman. (No convention of the association was held last year).

June 4-6, 1918.—Annual convention of the National Association of Master Plumbers, in St. Louis. Headquarters at the Planters Hotel.

June 26-28, 1918.—Midsummer meeting of the American Society of Heating and Ventilating Engineers, in Buffalo, N. Y.

◆

Miscellaneous Notes.

Chicago, Ill.—A new variety of coke, made from Illinois and Indiana coal, is being tested in the furnaces of the Willoughby Building's heating plant. According to the results already secured, this fuel may be used to solve the city's smoke problems, under the Garfield ruling of "no smokeless coal."

Portland, Me.—The twelfth annual dinner of the Plumbing, Steam and Sheet Metal Salesmen's Association of Maine, was held at Riverton Park Casino, Portland, March 11, and was the occasion of a rolicking reunion of New England representatives of the trade. New officers were elected as follows: President, Herbert S. Wakely, Bangor, of H. W. Johns-Manville Co., New York; first vice-president, D. J. Dever, New York, of E. B. Badger & Sons Co., Boston; second vice-president, George H. H. Lawton, Portland, of Portland Stove Foundry Co.; third vice-president, Joseph E. Herrick, Beverly, Mass., of the National Radia-

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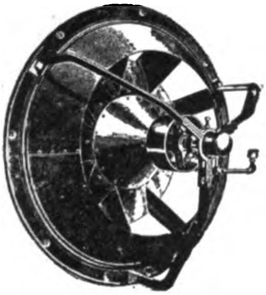
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The **Blackman** Fans are used for fresh air delivery and in duct systems, when no great pressure is involved.

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and have an abundant supply of pure, fresh air all the time.

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tor Co., Johnstown, Pa.; treasurer. A. M. Rosebrooke, Portland, of the Gurney Heater Mfg. Co., Boston; financial secretary, R. C. Parter, of the Smith & Abott Co., Portland; recording secretary, Eugene H. Winslow, of Winslow & Co., Portland.

New York Heating and Ventilating School held its annual dinner March 18 at the Building Trades Employers' Club. New York. C. A. Fuller, the instructor of the class, stated that about 60 of the former students are now in military service. Other speakers were Frank K. Chew, Walter S. Timmis, James A. Donnelly, George A. Schmidt and E. Erickson. Mr. Timmis extended an invitation to those present to become affiliated with the heating engineers' society He spoke particularly of the remarkable work being done for the government by the society's committee on submarine ventilation, the high value of which would be fully appreciated when the details are finally permitted to become public. M. J. Sage acted as toastmaster

Cleveland, O.—50,000 new homes are urgently needed in Cleveland to house the increase in population due to war industries, according to an announcement made at a recent meeting of the Cleveland Chapter of the American Institute of Architects. The necessary funds to solve the housing problem will be appropriated shortly, it is expected, by the government.

Signs of increased building activity are reported by the *American Contractor*, of Chicago. Among recent new projects that have been started is the construction of 300 tenant houses in Detroit by Theodore H. Eaton, to cost from $25000 to $3000 each, and the construction of 50 cottages at Waukegan, Ill., to cost $2500 each. The White Company is building a $500,000 factory in Cleveland. In St. Louis a $200,000 store building is being constructed by the S. S. Kresge Co. Among contemplated building operations are a $400,000 high school building in Erie, Pa.; a $500,000 high school in Rochester, N. Y.; and a $100,000 school in Clairton, Pa. In addition, a $2,000,000 ship building plant is planned by the Curtis Bay Ship Building Co., to be located at Curtis Bay, Md.

Hibbing, Mont.—Charles Foster, formerly manager of the St. Paul office of the Charles L. Pilsbury Company, has been appointed general superintendent of all the public utilities in Hibbing.

H. C. Winchell, Chicago, Ill., advertising agent, announces the removal of his offices to 20 East Jackson Boulevard.

Dodd-Dubosque Co., Inc., New York, has succeeded the advertising agency of J. D. Barnhill, Inc., at 110 West 34th Street. The company engages in business invest,-gations, sales plans and advertising.

John Morton, of the Johnson Service Co., New York, addressed the New York Engineers' Protective Society, at its meeting in the Bloomingdale Building, April 20, on "Thermostatic Control of Heating and Refrigerating." His address was illustrated by lantern slides illustrating the various types of thermostats and their construction features.

W. E. Clow, Sr., president of James B. Clow & Sons, Chicago, acted as chairman of the sub-committee of the Liberty Loan Committee for Chicago and vicinity.

National Metal Trades Association has changed the name of its official publication to the Open Shop Review. The association held its annual convention in New York, April 24 and 25, at the Hotel Astor.

New York State Industrial Commission has published a booklet of proposed rules relating to mines and quarries which were to be the subject of public hearings early in May. In connection with the proposed rules for the ventilation of mines, it is provided that "the operator of every mine, whether operated by shaft, slope, tunnel, adit level, or drift, shall provide and maintain for every such mine a good and sufficient amount of ventilation for such men and animals as may be employed therein, and shall cause an adequate quantity of pure air to circulate through and into all the shafts, winzes, levels, and all the working places of such mine.

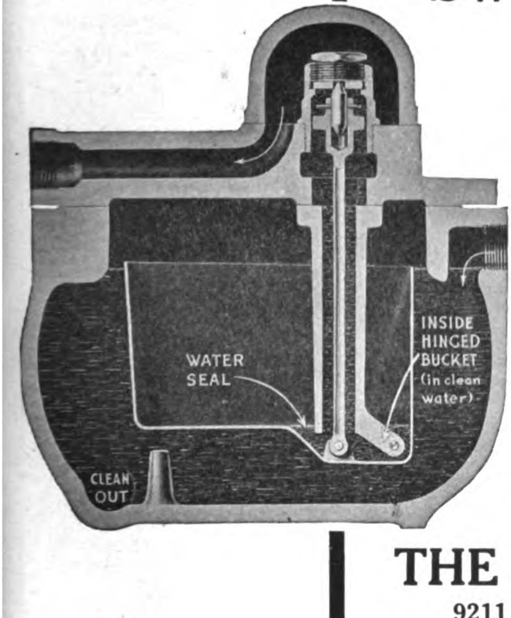
"*Note:* It is strongly recommended that the recommendations as prepared by the Bureau of Mines from time to time be followed." Copies of the circular may be obtained on application to the Bureau of Industrial Code, 230 Fifth Avenue, New York.

American Gas Institute and National Commercial Gas Association have completed plans for the amalgamation of the two associations. The new organization will be known as the American Gas Association. Officers will be elected and the organization completed at a meeting to be held in the Engineering Societies Building, New York, June 3.

Building Operations for March, 1918, continue to reflect the changes that have come about due to the state of war. The figures for 117 cities, as compiled by the *American Contractor, Chicago,* total $38,044,182, as com-

Swartwout *Hydromatic* TRADE MARK

STEAM TRAPS
pay big dividends



Coal is too scarce and high priced to waste. Even a little steam waste runs into a big amount of coal.

At 100 lbs. pressure, enough steam will escape through an aperture of 1/10 of 1 sq. in. in a ten-hour day to equal 845 lbs. of coal. At $4.00 a ton this amounts to $1.69 a day. This means 21,125 lbs. of coal a month or $42.50. You can't afford to have this waste.

Install Swartwout Hydromatic Traps and stop all waste. Every coil, every heater, every place where steam can waste must be trapped. Swartwout Hydromatic Traps are simple in construction, positive in action, and discharge nothing but water.

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THE OHIO BLOWER CO.
9211 Detroit Avenue, Cleveland, Ohio

pared with $84,842,307 for the corresponding period in 1917. It is to be remembered, of course, that these figures do not cover the enormous government construction work which would easily swell the total above that of March, 1917. Cleveland is the largest city showing a marked increase, the gain being due to two permits, one for a $600,000 building, issued to the Cleveland Electric Illuminating Co., and one for a $525,000 structure of the Division of Light, City of Cleveland. Washington, D. C., shows a 25% gain. New York City dropped from $14,340,636, a year ago, to $5,352,248, while Chicago dropped from $11,519,650, to $2,529,650.

Central Station Heating Notes.

Springfield, Ill.—Objections raised by the city of Taylorville to the meter rates charged by the Central Illinois Public Service Company, of Mattoon, for steam heating service in Taylorville, have been the subject of hearings before Frank G. Ewald, chief engineer for the State Public Utilities commission. The city also questioned the power of the utilities commission to order meters substituted when the company has a franchise from the city of Taylorville fixing flat rates for steam heating. Both sides were directed to file briefs.

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158 Whiting Street
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BRANCHES ALL CITIES

THE HEATING AND VENTILATING MAGAZINE

Cooperstown, N. Y. JUNE, 1918 1123 Broadway, New York

Inside Data on Central Station Heating

Practical Points, Gleaned from Long Experience, Covering Heating Mains, Fittings, Street Steam Traps, Service Connections and Consumers' Installations.

By W. H. FREHSEE,

Superintendent Steam Heating Department, Harrisburg (Pa.) Light and Power Company.

The Harrisburg (Pa.) Light & Power Company has 6¼ miles of underground steam heating mains, with 260 man-holes. The slip expansion-joint underground construction used in this system was first installed in 1886. Extensions have been made from time to time with the same type of construction. In 1900 the company adopted the American District Steam Company's construction, with variators and anchor specials, which eliminated man-holes, excepting where necessary to install valves or street traps.

All valves, fittings and bare pipe in man-holes are covered with 85% magnesia-block covering and plastered with asbestos plaster to a thickness of 4 in., and then painted with four coats of black water-proof paint to harden the insulation and make the fittings water-proof, as, in many cases, it was found that water would collect in the man-holes. The man-holes are also filled with shavings to the top of the valve stems.

All street traps are installed in separate man-holes. All slip expansion-joints in man-holes are covered with 85% magnesia-block covering and plastered and painted like the other fittings. Around each brass expansion-slip is placed a piece of galvanized iron, wired to cover the bolts and packing gland. The galvanized iron, in turn, is covered with 85% magnesia pipe covering, painted with four coats of black water-proof paint and finished with asbestos cement to make every part of the iron in the man-hole insulated. In the summer months, when the packing glands are re-packed, it is only necessary to take off the bands holding the covering, repack the glands and replace the same covering. Shavings are not placed in any man-hole having slip expansion-joints.

Through the procedure mentioned, it has been possible to lower the temperature in the man-holes by the thermometer reading to below 70° F. During the recent severe winter, with 1 ft. to 2 ft. of snow on the ground, covering the steam man-holes, 80% of these man-holes remained covered with snow throughout the cold period, showing that this careful insulation has more than paid in the conservation of steam.

There is no class of construction work which requires as much care in the selection of apparatus, or demands such direct attention, as the construction of underground steam heating mains and the design and installation of boiler-house equipment, particularly on account of the cost of installation. While it may be admitted that underground steam heating mains, properly designed, insulated and installed, cost more than any other type of underground construction, it is also true that, per dollar invested, the earning powers are greater. Operating reports containing accurate records of water evaporated at the plant and delivered into the heating mains, of transmission condensation, and of steam consumption in the buildings supplied, conclusively prove that the transmission losses in properly-constructed and well-insulated underground steam heating mains may be made very low.

In this connection one point should not be overlooked, that is, that the loss as measured by qauntity does not depend on the volume delivered; the capacity may vary from 5% to 100%. The amount of condensation per square foot of steam main surface is increased or decreased directly in proportion to the degree of perfection in the insulation.

THE FACTOR OF FRICTION

In a well-insulated steam main, pressure drops are largely due to consumers' demands and to friction. Consumers' demands or use are a source of income to the company and, therefore, attention should be given to the remaining factor, friction. Friction can be reduced by not restricting the flow at the fittings, all of which should be of full area. Unnecessary angles and sharp, 90° ells should be avoided by using long-radius, sweep-angle tees. Friction, it should be remembered, necessitates increased pressure which increases the cost of steam production.

POWER STATION EQUIPMENT AND RECORDS

The installation in the power station relative to supplying either live or exhaust steam to the underground steam heating mains should have adequate boiler capacity for supplying all engines to care for the peak load and to supply steam to the heating mains. Such boilers should have automatic stokers, automatic feed-water pumps, hydraulic ash-wash systems, condensers, separators on exhaust lines, series of two traps each on separators, back-pressure valves, main valves and reducing-pressure valves, with by-passes supplying live steam to the underground steam heating mains. All live and exhaust steam mains, fittings, condensers, heaters, boilers, etc., should be covered with 85% magnesia covering.

In order to retain the highest heating operating efficiency, the following records should be kept:

Daily and monthly maximum, minimum and average outside temperature, by use of recording thermometers.

Daily and monthly maximum, minimum and average wind velocity, by use of hygrometer or hygrodeik.

Daily and monthly consumption of coal.

Daily and monthly evaporation of water, accounting for all steam made but which is not eventually delivered into the heating system.

Daily and monthly kilowatt output, using both recording and indicating meters.

TILE DRAINAGE UNDER STEAM HEATING MAINS

The installation of tile drainage is a very important factor preserving the life of the insulation of the underground steam heating mains. It should be installed with the true intent of maintaining the steam heating mains dry at all times. In making these drains a trench should be dug 18 in. deep, 12 in. wide on each side of trench below the grade stake set for the steam main, with cross sections to the two lines every 50 ft. Place 4 in. of No. 3 broken stone in the bottom of the tile trench, lay the 4-in. farm-drain tile on broken stone with ends butted together, place a tar-paper strip 4-in. wide over each joint, then fill the tile trench with broken stone to 4 in. across the width of the trench. Connect drain-tile lines to sewer at intervals of not more than 1000 ft. if the fall is in the same direction for that distance. When there are changes in the alignment of the steam mains, it will be necessary to connect to the sewer at shorter intervals.

The importance of this tile construction can be readily seen. The writer has taken out old steam heating mains that had become too small, due to an increased demand for steam and for future extensions and has found, upon excavating, that the drain tile was completely filled with a silt foundation, making the tile under drainage of no value for the purpose originally intended. The tile had been laid in a bottom of clay or dirt soil, the joints being placed very unevenly or close together, one end being from ¼-in. to ½-in. open on the bottom. Seepage or surface water had percolated through the joints, softening the clay or dirt soil, embedding it in the trench and gradually filling it up.

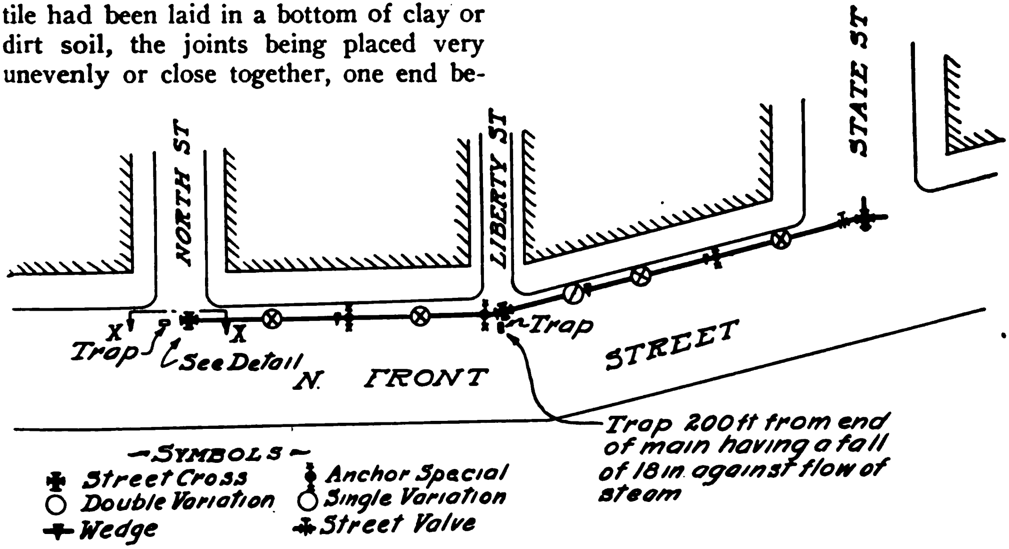


FIG. 1—ARRANGEMENT OF PIPING TO STEAM TRAP AT END OF ALL STEAM MAINS, REGARDLESS OF GRADE.

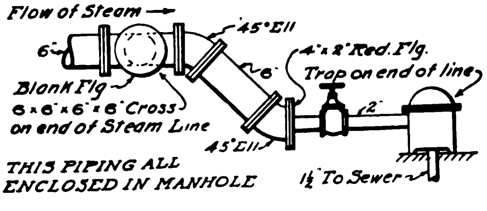
IMPORTANCE OF LEAKS.

A leak in the underground steam mains should be repaired immediately after evidence of the same is shown by surface or other indications. A small leak is often far-reaching in its results. The writer advocates using large-sized steam mains, reducing, when required, to the next smaller size, to lessen the drop in pressure due to friction. Small-sized mains and large reductions necessitate increased pressure at the plant. Large-sized steam mains have more area, giving greater volume with much less pressure.

All steam mains should be installed and insulated with the best type of covering to overcome condensation. Even fittings and bare pieces of pipe that are not covered by standard main insulation, should be covered with 85% magnesia-block covering and asbestos cement 2 in. thick, and then painted with black asphaltum. The painting makes the covering hard and water-proof. All brick boxes, man-holes, and brick ducts should be filled with shavings. Valves should be placed on all lateral mains and on main lines at least every third block.

STREET TRAPS

The installation of street traps is of vast importance in the maintenance and operation of the underground steam heating mains. A large number of central-station heating plants have no automatic water-feed regulators or pumps on the boilers. This is a very expensive mistake. The writer has found through



SECTION AT X—X (FIG. 1).

exhaustive tests on various central-station heating plants that a large amount of water and condensation gets in the heating mains due to the priming of the boilers or their being filled too full, due to careless hand-feeding. Also, when batteries of boilers are generating steam and from two to four of the boilers are not supplying their share of the steam, due to not having stokers or ash-wash systems, or to the fact that the fires need cleaning, making it necessary to fire the other boilers more rapidly and harder to make the desired pressure, these boilers siphon water to the steam heating mains, making saturated steam of a low heat-unit value. This saturated steam goes through the street mains and through the service connections into consumers' premises and registers on the consumers' meters. The saturated steam also requires more pressure at the central station and in the street mains and the consumers are compelled to carry additional weights on their reducing valves.

FITTINGS TO BE INSTALLED AT LOW POINTS

In all underground steam heating mains fittings should be installed at low points having drop bottom openings or pockets the same size as the pipe, also fittings should be installed every 1000 ft., regardless of grade. Take a 6-in. connection from the fitting direct to the trap in the manhole, this trap to be 2 ft. below the main. All fittings to the trap should be 45° ells.

On old steam heating mains, the writer has found a 2-in. tapping in bottom of cross at an intersection of streets at low grade and, 300 to 500 ft. beyond, the pipe grading back to this low point in the main to take care of all condensation. This arrangement, however, does not do so. The velocity carries steam and condensation up-grade to the ends of the mains into consumers' premises, registering on the meters.

It is very important to install a large-sized street trap from the end of the main or dead end, regardless of grade, in the man-hole, as shown in Fig. 1. The writer would advise installing a series of two large-sized steam traps in the manholes, as one trap may be out of service until inspected. A trap should be used that operates on various pressures, otherwise it will waste a large amount of steam before adjusting itself. Moreover, it is important that the trap should operate on less than 10 lbs. pressure. For that reason the writer, in his own practice, has installed one type of trap in manholes that will operate on from ½ lb. to 40 lbs. pressure. The writer also installs traps on the dead ends of street mains. In one instance, before these traps were installed, it cost $300 to $400 a month for repairs to street mains, due to water hammer and the resulting leaky joints and services. In one instance, with condensing coils and meters on the traps at dead ends of the line, the meter registration for the month of December, 1916, was 43,000 lbs., which, at 40 c. net per 1000 lbs., amounted to $172. In this connection it should be added that all street traps should be examined every week.

SERVICE CONNECTIONS TO CONSUMERS' PREMISES

All service connections should be taken off the top of fittings in the steam mains and graded back to the main. Fittings in service connections should be Y branches and 45° angle. No service connection should be less than 2½-in. in diameter, regardless of the small size of the building, as pipe above 2 in. has larger threads and more weight than the smaller sizes. Insist on large service connections to overcome pressure and friction by having the requisite area and volume. In our own experience, on the dead ends of a 4-in. or 5-in. steam main where, at times, the pressure was low, we had 1½-in. and 1¼-in. service connections and could not get any steam in the radiators. We insisted on running large service connections and on excavating we found from three to seven sharp, 90° ells in the service lines. The writer would insist on installing 2½-in. to 4-in. service connections with slight angles or 45° ells.

The following sizes of service connections are figured at 1lb. pressure:

Diameter, In.	Radiation, Sq. Ft.
2½	600
3	900
4	2200
5	3600
6	6000

All service connections to be installed same as street mains.

INSTALLATIONS IN CONSUMERS' PREMISES

The installation in consumers' premises increases or decreases the revenue derived from steam consumption in proportion to the satisfaction of the consumer in having his premises heated at a satisfactory rate. Therefore, examine all installations and have the consumer make all necessary changes. Keep a record of the character of the building, class of construction, thickness of walls, various exposures, single or double-glass thickness, tight or loose sash, tight-door sills, windows broken or not, cracks in walls. Also see that the foundation walls are tight, find cubic feet of space in building, square feet of radiation in building, type of installation, whether system is installed properly or not, changes to be made to system, and approximate cost of steam per season.

If the proposed consumer has a one or two-pipe indirect or vapor installation from his own boiler, would also record that, as outlined above. Check up radiation and space heated, examine the installation carefully and suggest any changes, having the consumer make same. By having the consumer remodel his installation according to the company's rules and regulations, much can be done in reducing the size of the meter bills.

The writer does not believe in supplying central heat to every one until the installations are made to conform with the company's rules and regulations. We would lose many consumers if we did not insist on this, due to large monthly bills.

When we have a complaint from a consumer about his monthly meter bill, we give it immediate attention. First we examine the street traps in the vicinity to see if they are working properly. Second, we examine all outside doors, windows, door sills or other openings. Third, we test the service connection coming in from the main. This last is most important, as with steam mains that have been installed for many years, when little attention was paid to construction as regards proper grade of traps or where there were not traps enough in the line, condensation and saturated steam from the mains will come in through the service connections and register on the meter.

ADJUSTMENT OF CHANGES WHEN METER FAILS TO REGISTER.

Where we have trouble with the meter not registering we adjust the bills according to the following table of percentages for the various months:

October	7%
November	13%
December	18%
January	18%
February	15%
March	16%
April	5%
May	5%

We have rules and regulations pertaining to service connections and all inside installations which the fitters must follow.

As already stated, we do not allow any 90° ells. All pipes are to be of a certain size for a given amount of radiation. All fittings must be covered.

No radiator connection from a riser is to be less than 1¼-in. Large-sized mains are insisted upon to give area and volume. Finally we heat our new installations to 72° F. in zero weather on from 1 oz. to 3 oz. pressure.

ESTIMATING THE HEATING COST FOR A NEW CONSUMER.

In estimating on a new consumer, in order to give him an idea of what the steam bills will be, we figure from $3.50 to $5.00 per 1000 cu. ft. of space per season, but we find that $4.00 per 1000 cu. ft. is within 10% of being correct.

VAPOR SYSTEM OF HEATING ADVOCATED.

We strongly advocate the use of the vapor system of heating as being the best to use with central station heating. While costing a little more to install, it is the most economical in the consumption of steam, saving from 20% to 25% over the ordinary steam systems. In fact, practically all of the installations now being made are of the vapor type. We would recommend in connection with the installing of a steam system the use of thermostats which, we believe; will pay for themselves in the saving of steam.

The following pipe sizes are recommended in connection with the installing of ordinary heating systems:

Radiation, Sq. Ft.	Pipe Size, In. Diam.
Up to 600	2½
600 to 900	3
900 to 1400	3½
1400 to 2000	4
2000 to 3000	5
3000 to 4500	6
4500 to 7000	7
7000 to 9000	8

Cross arms for small radiators should be 2 in. and, for larger-sized radiators, 2½ in., with risers 2 in. to first floor, 1½ in. to second floor and 1½ in. to third floor.

PIPE SIZES FOR VAPOR HEATING

The following pipe sizes are recommended for vapor heating systems:

Radiation Sq. Ft.	Main In. Diam.	Return In. Diam.
Up to 600	2½	1½
600 to 900	3	1½
900 to 1400	3½	1½
1400 to 2200	4	2
2200 to 3600	5	2
3600 to 6000	6	2½
6000 to 8500	7	2½

Cross arms for small radiators should be 2 in., with 1¼-in. return cross arms For larger radiators cross arms should be 2½-in., with 1¼-in. return cross arms. All connections to be taken off

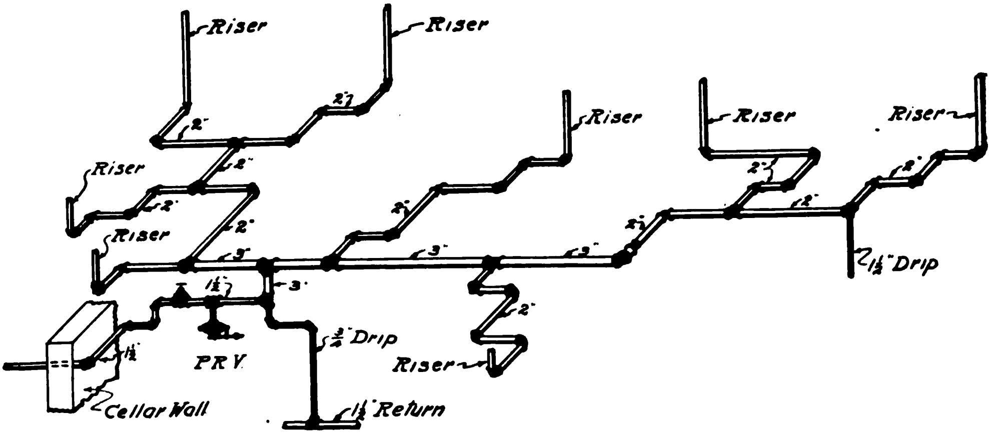


FIG. 3—OLD ONE- AND TWO-PIPE SYSTEM AS ORIGINALLY INSTALLED IN HARRISBURG BUILDING WHERE RADIATORS WOULD NOT HEAT.

with Y branches and 45° ells used in place of tees and straight ells.

CHARGES FOR CONSUMERS' INSTALLATION

In estimating for steam-fitting work for consumers we charge for everything in connection with the work, excepting the meter, which remains the property of the company. On a one-pipe steam heating job, our estimated contract price will average about $1.00 per square foot of direct radiation. On vapor installations, our contract price will average about $1.25 per square foot of radiation. For estimating the cost of running service pipes we use the following figures:

	Cost per Lineal Foot.
Excavating	$1.00
2½-in. pipe	.30
3-in. pipe	.40
4-in. pipe	.62
5-in. pipe	.83
6-in. pipe	1.08
7-in. pipe	1.20
8-in. pipe	1.35
5-in. wood-lined casing	.80
6-in. wood-lined casing	.90
8½-in. wood-lined casing	1.03
Repaving of street	.70
Labor laying service pipe	.50
Drayage, brick-work, etc.	.20

In installing steam heating jobs we figure on using economy coils containing 20% of the entire amount of radiation in the building, for cooling the condensation before it passes through the meter to the sewer.

PROVISION FOR TESTING PRESSURE ALONG LINE.

For testing pressure along the line at various points gauge connections should be installed to which a steam gauge can be attached at frequent intervals, especially during the extreme cold weather. This method of testing gives the amount of pressure along the line and is very important in reducing the pressure at the power station. Where pressure on dead ends is excessive, from 7 to 20 lbs., we reduce this to 2 lbs. on the last consumer on the extreme end of the line, thereby sending increased pressure to the low points along the line. By keeping close watch on these pressure points it is possible to reduce the pressure at the power station as much as 12%. These tests should be made once a month, or oftener, according to the weather.

POINTS ON THE USE OF METERS

The object of installing meters in consumers' premises is to bring about an equitable relation between the heating

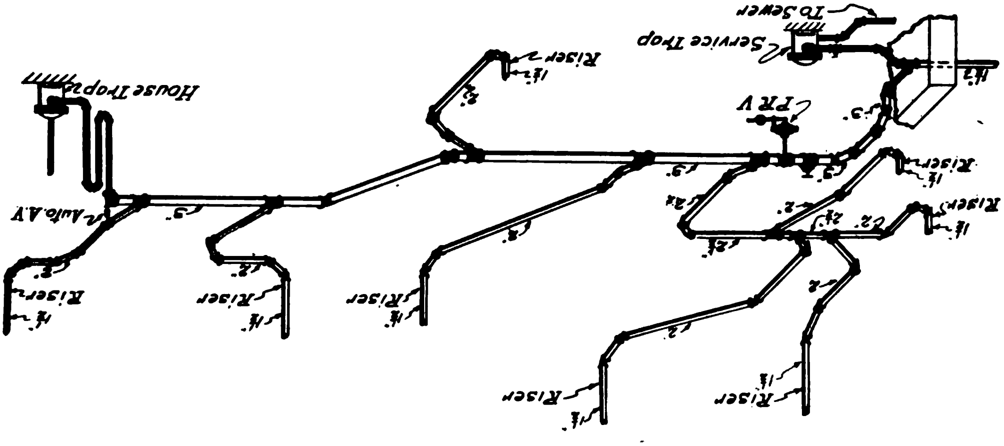


FIG. 4—CHANGES MADE IN OLD ONE- AND TWO-PIPE SYSTEM WHICH REMEDIED THE DIFFICULTY BY ELIMINATING 90° ELLS.

company and the customer, by recording the exact amount of steam delivered. The meter is connected to the extreme low point or end of the consumer's piping system, so that all the steam condensed in the building must be passed through before being discharged to the sewer. It is of the greatest importance that the meter should be of the proper capacity, the correct size being determined by definite rules. Otherwise, at maximum periods of flow, an accurate registration will not be obtained.

The proper-sized meter of the bucket type to install can be determined by multiplying the number of square feet of radiation in the building by 0.40. This will give the flow of water in pounds per hour. The proper meter can then be selected on the following basis: No. 2 meter, 150 lbs. per hour; No. 3 meter, 375 lbs. per hour; No. 4 meter, 750 lbs. per hour; No. 6 meter, 1500 lbs, per hour; No. 7 meter, 3000 lbs. per hour; and No. 8 meter, 15,000 lbs. per hour.

The meter must be set level. It should also be installed with a sufficient number of unions to permit of easy removal for cleaning and inspecting. The outlet of the meter should be located above the sewer to insure a free flow by gravity from the meter. The pipe should be as short as possible to insure free flow and the discharge pipe leading to the sewer should never be reduced in size. A sewer trap should in all cases, be installed to prevent water or sewer gas from backing up into the meter.

A careful inspection of the meter is one of the most important duties of the meter-reader who should note that the meter sets level, that meter seals are intact with no evidence of tampering, that the movement of the bucket is not impeded in any manner, and that all condensation from piping and radiators passes through the meter.

Meter readings should be taken once a week. At the end of each season all meters should be properly tagged, removed and taken to the testing-room where they should be tested, cleaned, their bearings lubricated, all adjustments made and then re-tested before being placed in the consumers' premises. The proper operation of all meters is of the greatest importance as upon their accuracy depends the confidence of the customers and the general public.

The following sizes of nozzles should be used on testing meters to insure proper rate of flow for the various meter sizes:

Meter.	Size of Nozzle, In. Diam.
No. 2	7/64
No. 3	11/64
No. 4	1/4
No. 5	23/64
No. 6	34/64
No. 7	3/4
No. 8	1
No. 10	2

SIMPLE METHOD OF TESTING METER.

Each compartment of the bucket of the meter is adjusted to empty when filled with the proper weight of water. The actual testing of a meter consists of weighing the amount of water contained in the barrel, noting the position of the bucket, up or down. The determined amount of water is then permitted to pass through the meter, after which scales are again balanced and the difference calculated, when a second reading of the meter and test dial is made. Meter buckets must be in the same position as at the beginning of the test. The comparison between the actual weight of the water and the recorded weight determines the percentage of accuracy. Careful records should be kept of the meters cleaned, adjusted and tested, together with date of test.

The essentials of proper meter operation are as follows:

The meter must be of proper size and capacity.

Meter must be set level.

Condensation should flow into meter from cooling coil.

Temperature of water should not be over 90° F. in going into meter.

Meter outlet must not be bushed.

Meters should be read and inspected frequently.

All meters should be tested at least once a year.

Proper facilities should be provided for testing meters.

As the care and operation of the meters are two of the most important factors in the success of central-station steam heating, this department should be placed in the charge of a skilled mechanic who will appreciate the importance of proper meter registration. Meters should not be tested on the consumers' premises, but in the testing-room at the power station.

Before testing meters, have all testing equipment examined by the sealer of weights and measures so that you will be sure your testing apparatus is correct. You will then have him to corroborate your statement in case of a controversy between the company and the consumer regarding the test made on the meter.

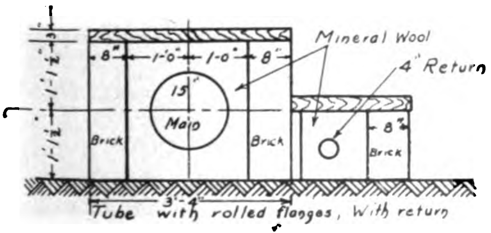
From the Old to the New in Steam Pipe Conduits

With Special Reference to the Types Developed by the New York Steam Company.

A moving picture of the development of underground pipe construction in New York City is afforded by the accompanying illustrations which show all the important changes made in the form of conduit used by the New York Steam Company since the original type was adopted in 1880.

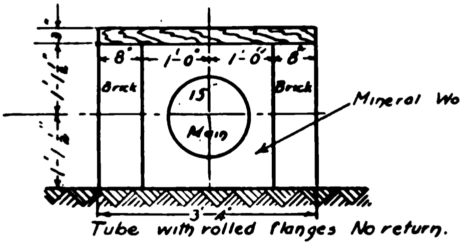
In this original type (Type A), it will be noted that there was no underdrainage whatever and that the conduit was built with an earth bottom. It was evidently the opinion in those days that the losses downward were negligible. The pipe carried in this conduit was wrought-iron, rolled or expanded into cast-iron flanges, in similar fashion to the tubes in a boiler. Types A and B were used for approximately the ten-year period from 1880 to 1890. A type of construction (Type C), practically the same as Type B, but with screwed pipe and cast-iron screwed flanges, was used during the ten-year period from 1890 to 1900.

Underdrainage was first provided in the type adopted in 1900 (Type E), which remained standard for approximately the next ten years, or until 1910. This underdrainage consisted



TYPE A.

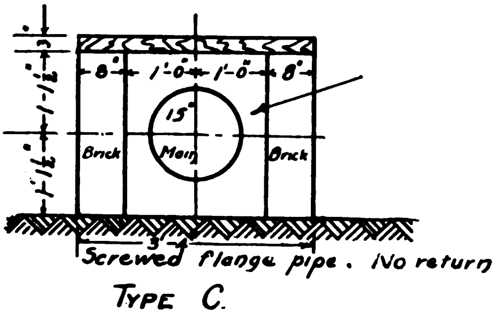
No underdrainage—Earth bottom.



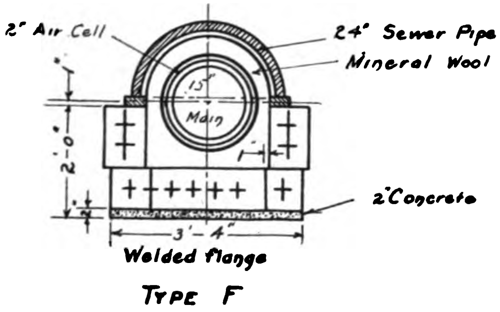
TYPE B.

No return

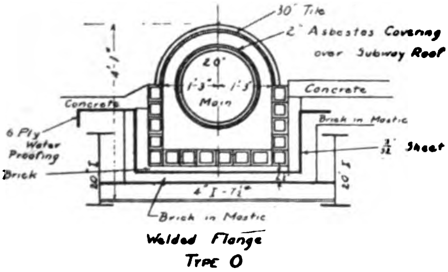
ORIGINAL TYPES OF STREET MAIN CONSTRUCTION AS USED IN NEW YORK IN 1880.



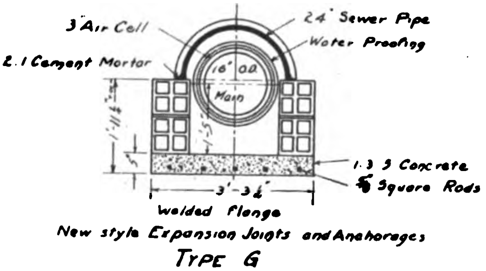
CONSTRUCTION USED DURING THE PERIOD 1890 TO 1900.



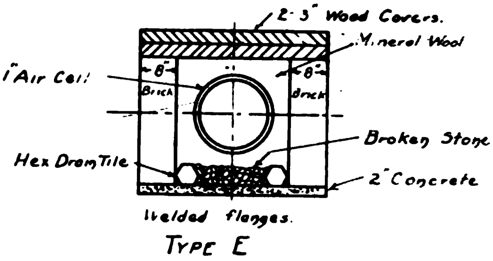
STANDARD CONSTRUCTION FOR FIVE-YEAR PERIOD TO 1915.



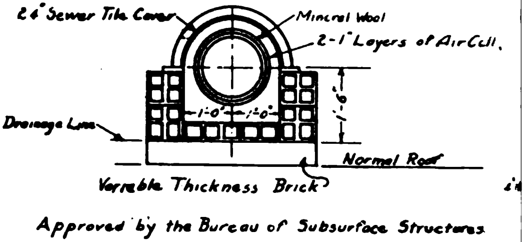
CONTEMPORARY WITH TYPE F, USED FOR SPECIAL SUBWAY WORK, WHERE CUT IS SHALLOW.



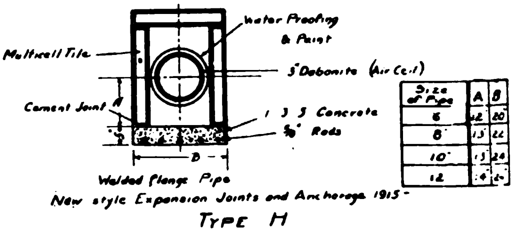
STANDARD CONSTRUCTION FOR 14-IN. AND 16-IN. MAINS SINCE 1915.



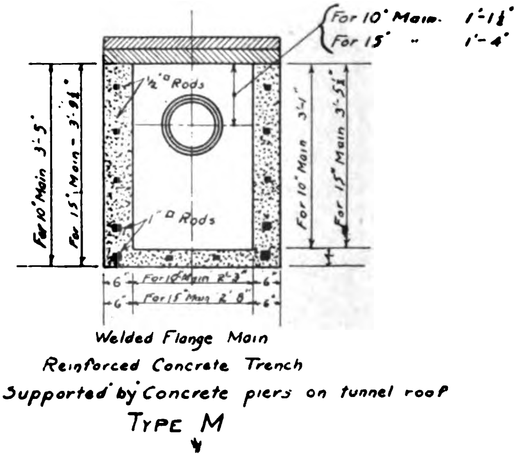
CONSTRUCTION FOR TEN-YEAR PERIOD APPROXIMATELY FROM 1900 TO 1910.



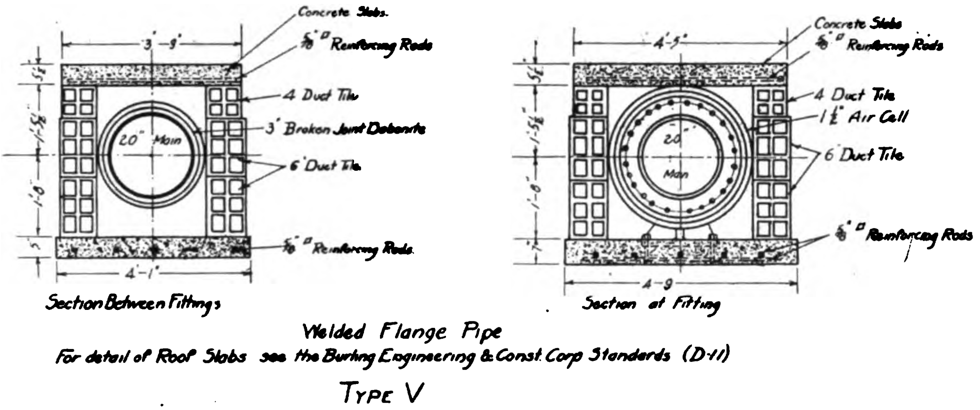
CONTEMPORARY WITH TYPE F. USED FOR SPECIAL SUBWAY WORK WHERE CUT IS SHALLOW.



STANDARD CONSTRUCTION SINCE 1915 FOR MAINS UP TO AND INCLUDING 12-IN. PIPE.



SPECIAL CONSTRUCTION, CONTEMPORARY WITH TYPE E, USED FOR STRENGTH OVER DEEP BACK-FILL.



STANDARD CONSTRUCTION SINCE 1915 FOR 20-IN. MAINS.

of broken stone held in place by hexagonal drain tile and resting on a bottom of concrete 2 in. thick.

Type F is the general form of construction used from 1910 to 1915. This has a 2-in. concrete floor, but no reinforcing and the space between the sectional covering and the housing was filled with mineral wool. A conduit was also placed beneath the pipe, serving as a drainage space and to support the mineral wool.

Type G, with reinforced concrete base, 3 in. of sectional covering, no mineral wool and merely an open space for drainage beneath the pipe, was first used in 1915 for all sizes of pipe.

In 1916 the so-called standard multicell construction (Type H) was used for pipe sizes up to 12 in. in diameter only, while Type G was continued for 14-in. and 16-in. pipe and Type V for 20-in. pipe.

Type M is contemporary with Type E and was used where mains were restored over the Hudson & Manhattan tubes where there was a backfill of from 10 ft. to 18 ft. over the tubes. The reinforced concrete box was supported by concrete piers extending down to the roof of the tunnel, the box serving as a bridge between piers set 20 ft. apart.

Type N is contemporary with Type F, but was used only on the subway roof where there was but little space between the subway roof and the street paving.

The construction shown in Type O is contemporary with the Type F and was used in the Sixtieth Street crossing of the Lexington Avenue subway where the cross pipe had to be kept at as low a level as possible to accommodate the longitudinal subsurface structures in Lexington Avenue. Type Q was also in use at the same period as Type F, and was for the same purpose, but possibly under slightly different conditions than Type N.

Figuring Steam Consumption in Radiation

Amount Required Per Square Foot of Direct Required Radiation To Maintain an Inside Temperature of 70° F., with Various Outside Temperatures.

BY J. A. STRAWN

Other conditions being equal, the heat loss from a building is, of course, proportional to the temperature rise; that is, to the difference between the temperature of the building and the outside air. As the condensation recorded by the meter attached to the system served by a central station heating plant is very nearly proportional to the heat loss from the building, this may be expressed in equational form as follows:

$$\frac{C}{R} = f\,(T_B - T_o) \qquad (1)$$

In which C = condensation in pounds per day.

R = direct radiation required in square feet.

f = Factor depending upon kind of system, character of building, quality of regulations, etc. This factor has been found very nearly constant for any one of a large number of buildings observed.

T_B = Inside, or building, temperature.

T_o = Average outside temperature for the days considered.

Transposing and substituting 70° for T_B:

$$f = \frac{C}{R\,(70 - T)}$$

But the condensation per hour from a square foot of direct radiation under 1 lb. steam pressure giving up 250 B.T.U. is 250/971.2 = 0.258 lbs.

Adding 10% for condensation losses in mains, risers, etc., and letting x = number of hours per day that steam is necessary at various outdoor temperatures:

$$f = \frac{0.284x}{R\,(70 - T)}$$

When R = 1, $T_o = -10°$ (the system is assumed to be in use 24 hours per day) and f = 0.0853.

Then

$$x = \frac{0.0853\,(70 - T_o)}{0.284} = 0.3(70 - T_o)$$

Computed values of x for various outdoor temperatures are as follows:

Outdoor Temperature Degrees F.	Hours of Use
—10	24
0	21
10	18
20	15
30	12
40	9
50	6
60	3
70	0

Charts obtained from a recording instrument, the pen of which was actuated by the stem of the reducing valve in the heating system of a thermostatically-controlled building have shown that the hours of use computed above for various temperatures are reasonably accurate.

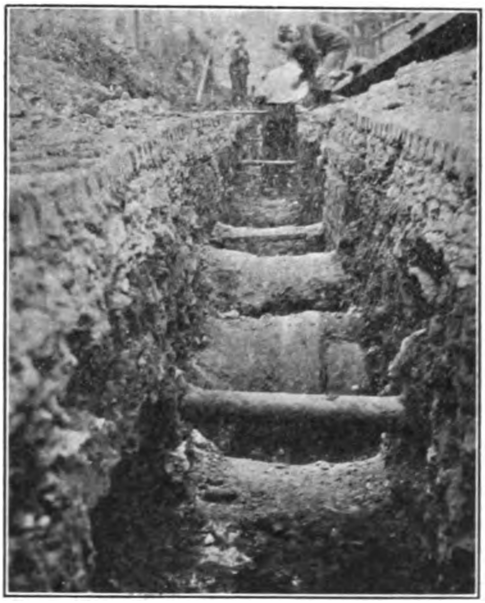
Equation (1) has been found very useful by the writer in estimating consumption in cases where a meter had stopped, or given a faulty registration for any cause. It has been found, however, that it is not as applicable to consumptions of customers operating under flat rates as to the consumptions of customers operating under meter rates, as the former class is much more liable to cool rooms by means of open doors and windows, than to prevent overheating those rooms by shutting off the steam supply automatically or otherwise.

Problems in Underground Pipe Construction

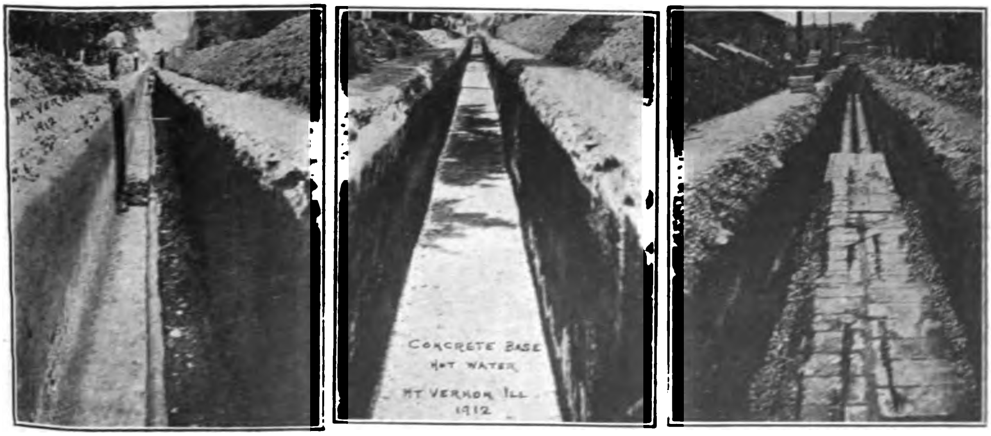
A Study in Contrasts Between the Character of the Work in Medium-Sized Cities and in the Downtown District of New York.

The accompanying views, taken "on the job," are typical of present-day underground pipe construction for central station heating systems and, to a degree, tell their own story. It will be observed that in the ordinary run of underground piping there is fairly plain sailing. Obstructions such as those shown in the Harrisburg, Pa., installation are somewhat out of the ordinary, while those shown in the downtown New York district are in a class by themselves.

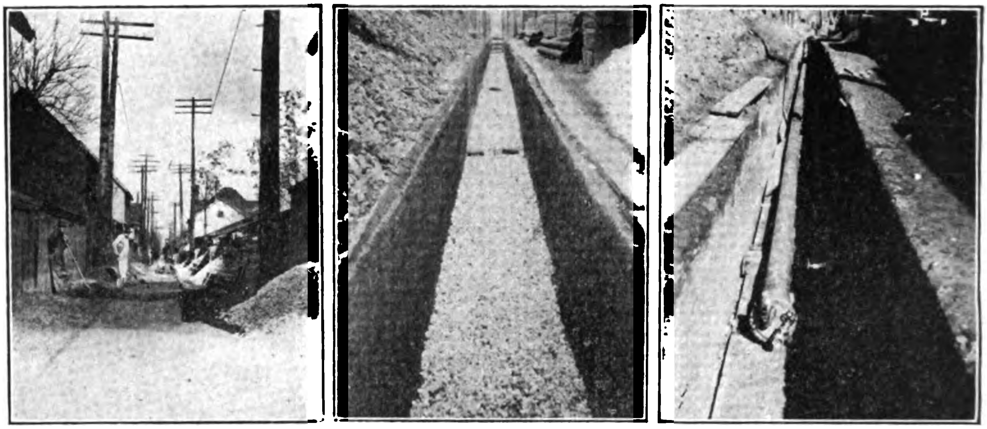
For months the downtown street corners in New York have resembled mining excavations, and the patience of the public has been well-nigh exhausted in waiting for the various runs and twists of piping to be untangled and put in shape so that the street could be properly surfaced. A study, however, of the typical situations shown herewith will make it



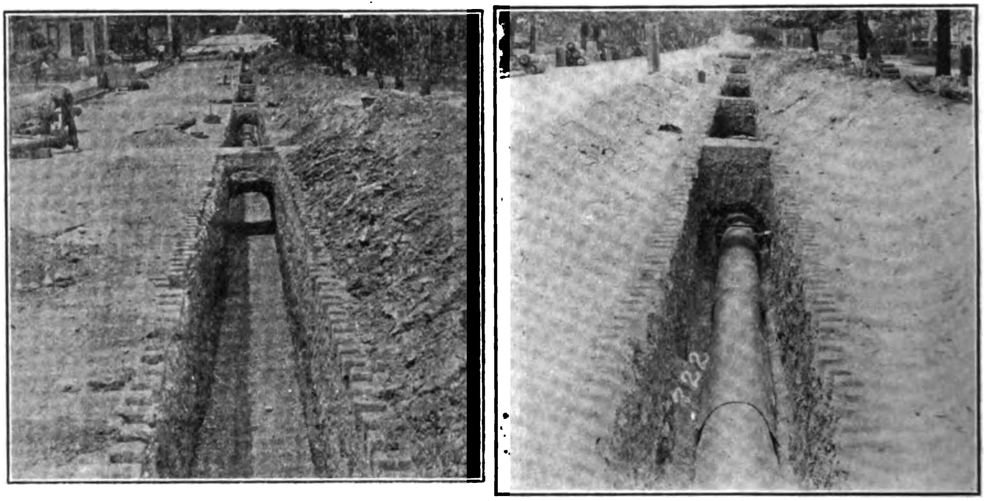
OBSTRUCTIONS IN HARRISBURG, PA., PIPE TRENCH.



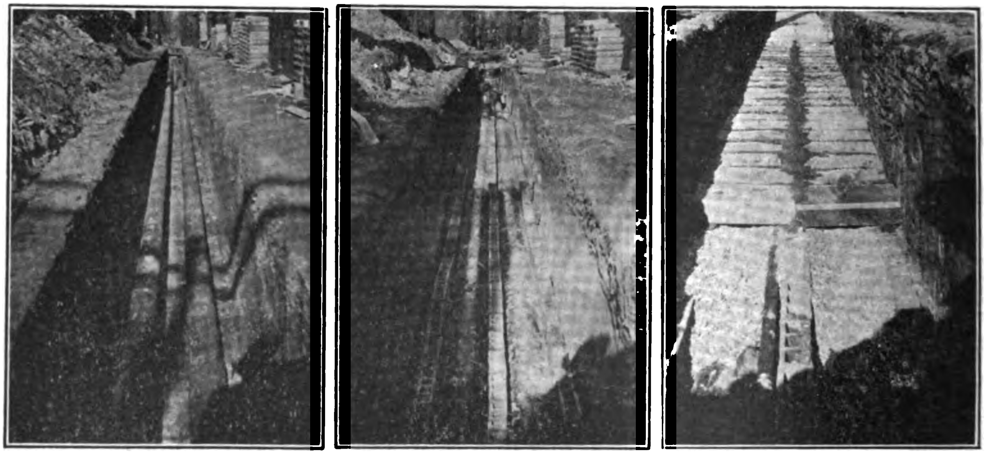
SEQUENCE OF FLOW AND RETURN HOT WATER INSTALLATION, MT. VERNON, ILL.



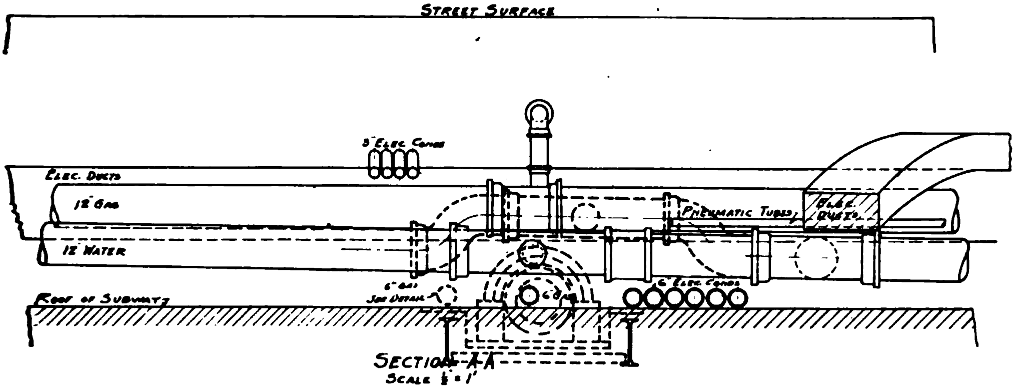
SEQUENCE OF FLOW AND RETURN HOT WATER INSTALLATION, SPRINGFIELD, ILL.



SEQUENCE OF STEAM MAIN INSTALLATION, ANDERSON, IND.



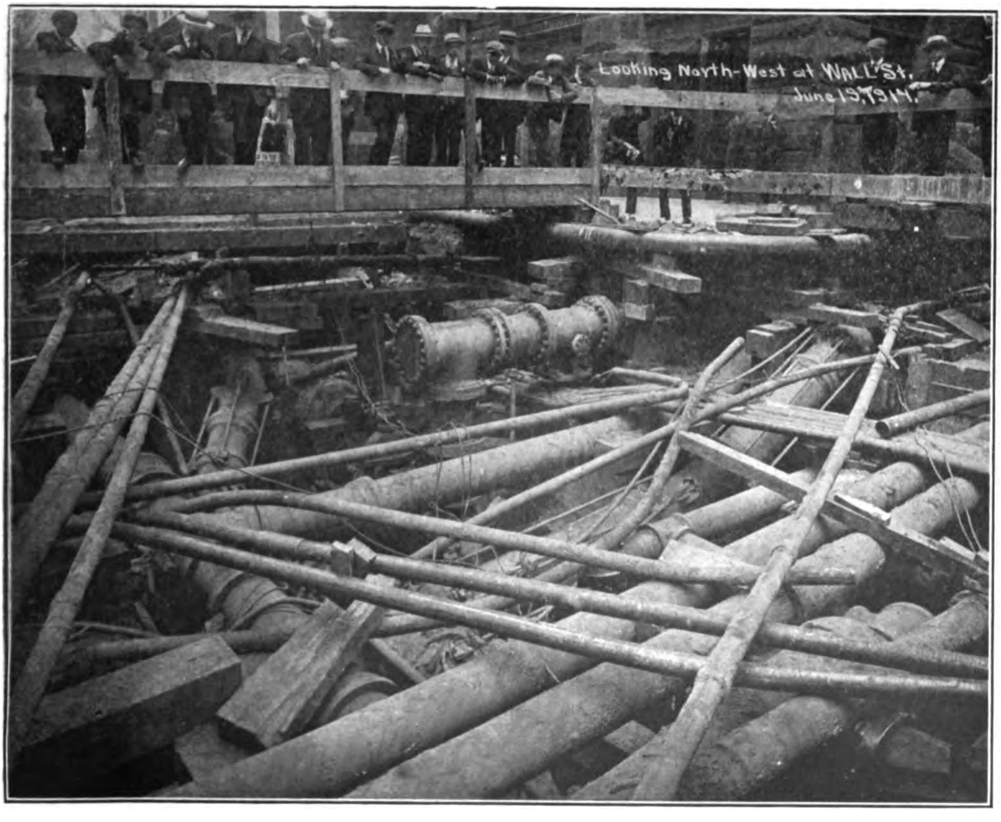
SEQUENCE OF FLOW AND RETURN HOT WATER INSTALLATION, SPRINGFIELD, ILL.



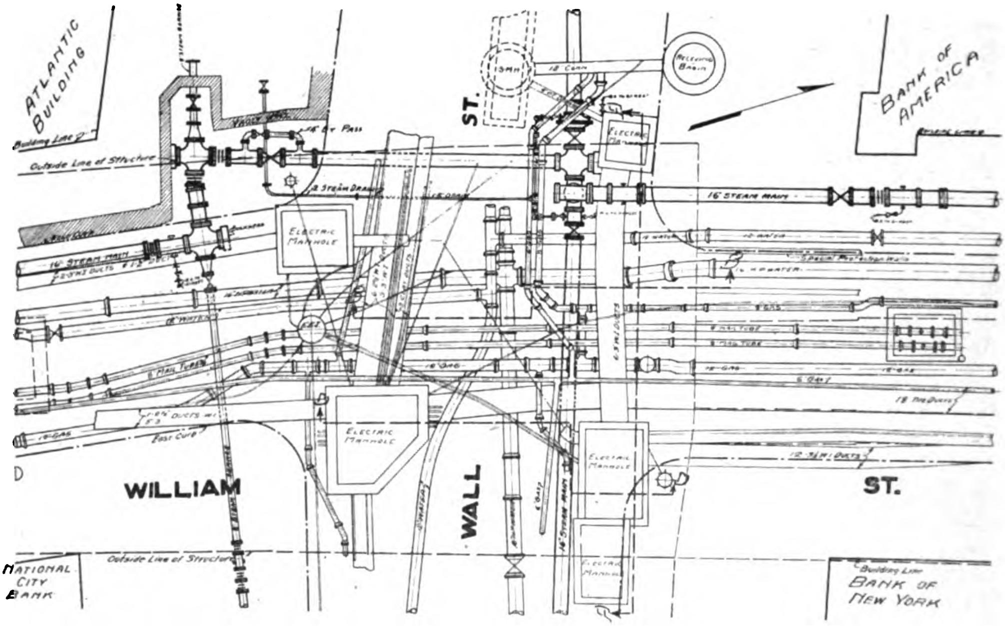
ONE OF THE MANY PROBLEMS AT THE INTERSECTION OF CEDAR STREET AND BROADWAY, NEW YORK.

apparent at once to those experienced in this class of work why it was that the streets were open so long and the wonder is, not that it took so many weeks and months to effect a satisfactory arrangement of the piping, but that it was possible to make any arrangement at all capable of giving service.

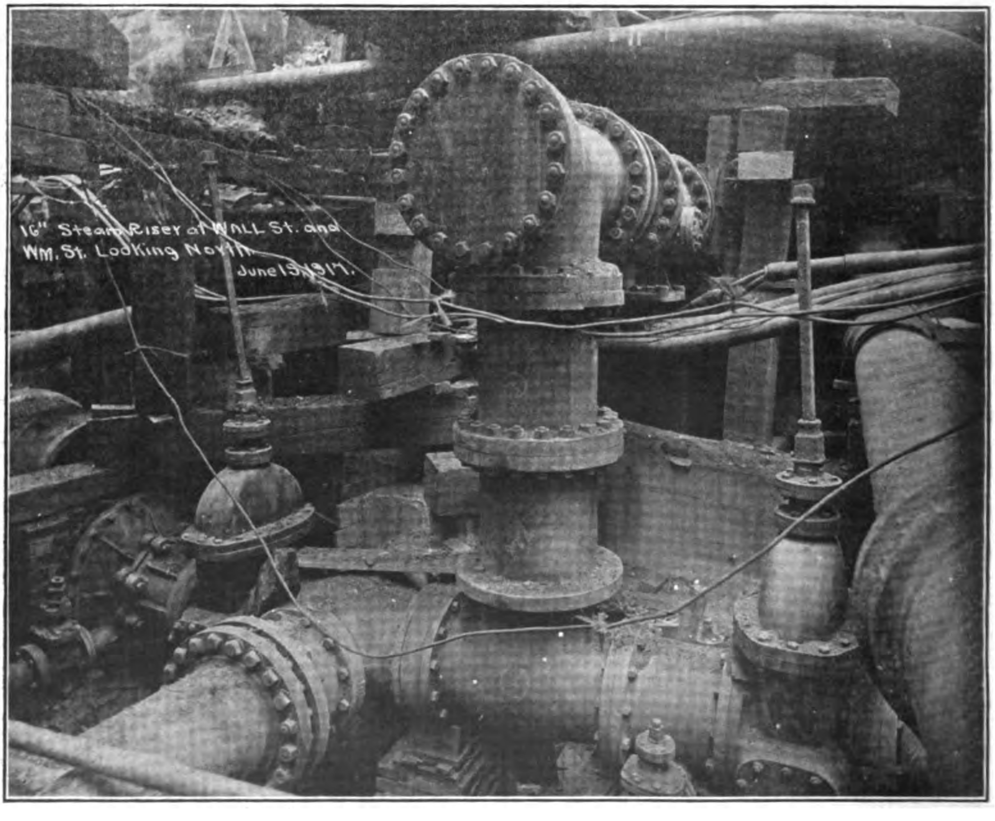
The illustrations of the New York streets are intended to feature in particular the mains of the New York Steam Company, which company has been engaged for some time in re-



CONDITIONS ENCOUNTERED AT WALL AND WILLIAM STREETS, NEW YORK.



PLAN OF PIPING AT WALL AND WILLIAM STREETS, NEW YORK.



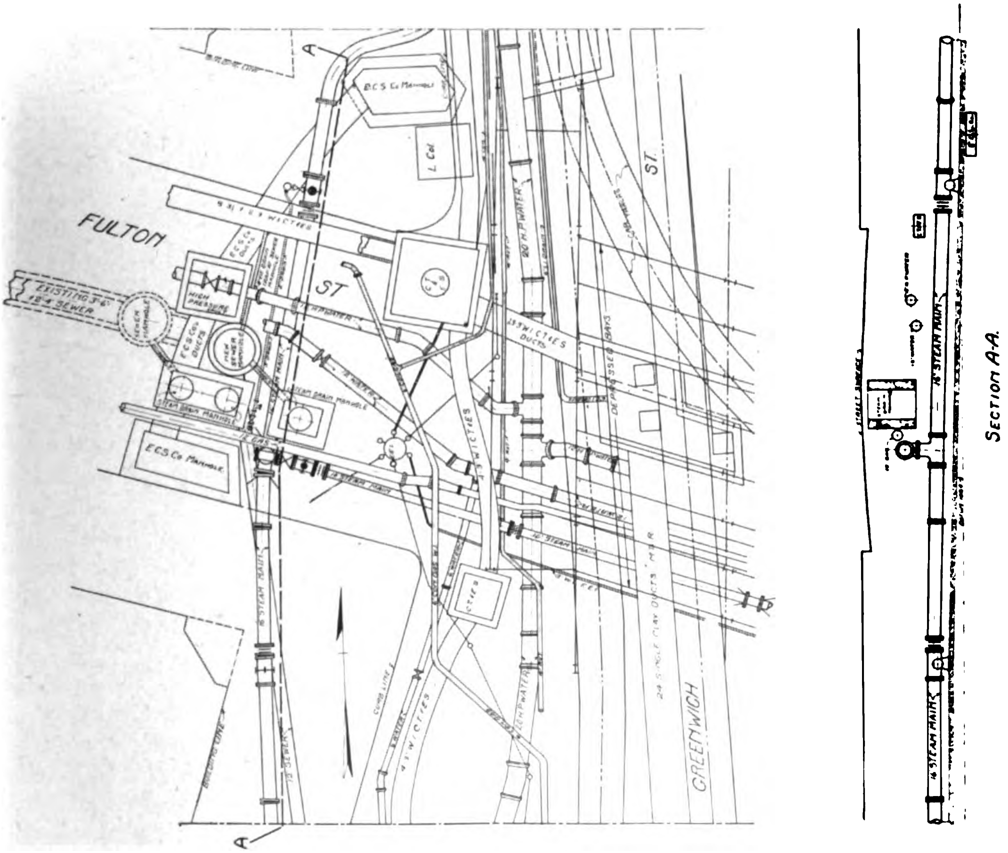
DETAIL OF 16-IN. STEAM RISER AT WALL AND WILLIAM STREETS, NEW YORK.

building its pipe lines. H. A. Fisher, engineer of underground construction for the New York Steam Company, through whose courtesy the accompanying pictures were obtained, states:

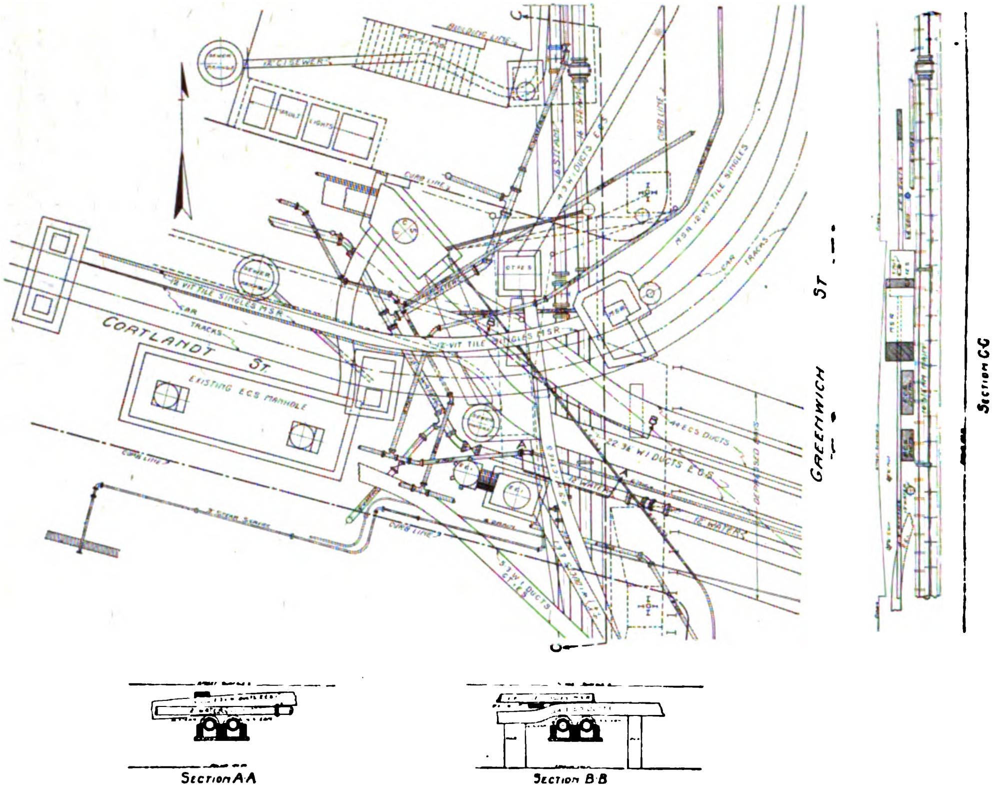
"I do not know of an obstruction to the installation of underground mains that we have not had to contend with within the limits of our system, from rock to quicksand, underground springs to tidewater, and from supporting elevated column footings to underpinning of buildings."

Special attention is called to the drawings of the piping tangles at Cedar Street and Broadway, Wall and William Streets, Greenwich and Cortlandt Streets and Fulton and Greenwich Streets. These drawings will repay close study as they reveal many of the difficulties encountered.

Taking the view showing the intersection of Cedar Street and Broadway, where a 16-in. main is installed, it was necessary to alter every structure at the intersection, involving innumerable preliminary designs and sketches for use in connection with securing consents from the various companies involved. Two 12-in. and one 24-in. water main and one 20-in. gas main had to be raised, Commercial cables shifted to a new position, Consolidated Telegraph & Electric Subway Company's manhole altered and subway ducts raised, vault of building changed, Empire Subway Company's bank of ducts shifted to the north, a depressed bay installed between bends of roof structure of the interborough subway, duct lines and water main moved to facilitate the placing of a special bend of the steam



PLAN OF PIPING AT FULTON AND GREENWICH STREETS, NEW YORK.



PLAN OF PIPING AT CORTLANDT AND GREENWICH STREETS, NEW YORK.

main, and the yoke supports of the New York City Railway Company changed, and new drains installed to sewers. All work during week days was done beneath the street decking; traffic had to be maintained at all times. Work on the depressed bay of the subway roof had to be done at night, at which time the tracks below were carefully patrolled.

Another set of conditions was encountered at Wall and William Streets, also in connection with one of the steam company's 16-in. mains. Due to the net work of subsurface structures at this intersection, it was necessary to install the mains underneath the sidewalk (the only available space) in William Street, connecting to the Wall Street main through structures built at a depth of 11 ft. Various types of special fittings were used as shown in the close-up photograph, such as anchor service box, valve dummy of extra heavy standard, and changed drill casting, variators, service spools and valves of New York Steam Company standard. This intersection is typical of several in William Street. It may be interesting to note in the plan the by-pass of the 16-in. main valve, at the southwest corner, with 8-in. service to the Atlantic Building and the 8-in. service to the National City Bank.

The double line in Greenwich Street, at Cortlandt Street, and the main at Fulton and Greenwich Streets, were installed under the sidewalk on account of the extreme height of the subway, the roof of which at Cortlandt Street, is about 2 in. below the street surface.

CHICAGO COMMISSION ON VENTILATION

Report on Air Conditions at the Paris Garter Factory

II

EDITED BY HARRY M. HART.

(Concluded from May issue.)

The first part of this report gave details of the tests made on various floors under normal operating conditions. The concluding portion of the report, here published, deals with a series of tests showing the effect of the exhaust fans and nautral ventilators at the ceiling of the top floor on the air movement throughout the building. There is also included a discussion of both series of tests.

Test No. 10, March 3, 1917, 5th Floor.

All doors and windows closed.
Outside weather conditions—Temp. 32°
Relative humidity 90%.
Direction of wind,—N-NW.
Velocity—9 miles per hour.
Time—10:00 A.M.

Exhaust Fans:

North exhaust fan, speed 600 RPM, velocity 1230,
Volume 8680 CFM.
South Fan, speed 588 RPM, velocity 1140, Volume 8060 CFM.

Globe Ventilators:

2 closed—6 open.
Average negative velocity through ventilators 160-ft. per minute.
Total, 3072 CFM.
Average temperature of the room 71°F.
Average relative humidity—22⅔%
Average CO_2—5.46
Temp. of air discharged through exhaust fans, 72°F.
Relative humidity of same—20%.

The results of above test show that fans were exhausting a total of 16,740 CFM. 3072 CFM. was coming into the room through the Globe ventilators and the balance was coming into the room through the cracks and crevices around the doors and windows.

During this test, complaint was made of the cold drafts near all the windows, indicating excessive inward leakage at these points, also objectionable odors near toilet adjacent to elevator.

The absurdity of having both exhaust fans and gravity ventilators in one room is shown very well in this test where the large volume of air handled by the fans caused a down draft into the room through the ventilators. Probably very little of the air pulled through the ventilators ever reached the breathing zone, as both fan and ventilators are in or near the ceiling.

The uncomfortably cold drafts near the windows as well as the objectionable odor near the toilet illustrates the necessity of providing some definite entrance for the air when exhaust fans are used, instead of depending on leakage.

The amount of heating surface installed on this floor is barely sufficient to compensate for the direct heat losses when the outside temperature is 10°, and has no excess capacity to care for warming the air for ventilation. Consequently the normal operation in cool or cold weather is to ignore the exhaust fans and depend on gravity ventilation alone.

Under the conditions in effect at this time this test was made, the doors from the toilet-rooms acted as air supply openings and odors entered the room from both toilets. The toilet adjacent to the elevator shafts naturally is a greater offender in this respect than the other, the air being doubly polluted as it must first pass from one of the lower floors through the toilet on that floor to the elevator shaft. up the shaft and through the toilet on the fifth floor into the main room.

The design of the plant in this particular cannot be too strongly condemned. The elevator shaft should not be permitted to act as a vent flue in any event, particularly of toilet rooms, as in this case.

Test No. 11, March 5th, 1917, 5th Floor.

All doors closed and three windows slightly open.
Outside weather conditions—Temp. 24½°F.
Relative humidity—75%.
Direction of wind—NE.
Velocity—4 miles per hour.
Time—4:00 P.M.

Exhaust Fans:

North exhaust fan, speed 200 R.P.M., velocity 283.
Volume 1985 C.F.M.
South fan, speed 206. R.P.M., velocity 295. Volume 2065 C.F.M.

Globe Ventilators:

2 closed—6 open.
Average positive velocity through ventilators 150 ft. per minute.
Total 2880 C.F.M.
Average temp. of the room 72°F.
Average relative humidity 17½%.
Average CO_2—
Temp. of air discharged through exhaust fans, 75°F.
Relative humidity of same, 17%.

The results of the above test show that the fans were exhausting a total of 4050 C.F.M. and the Globe ventilators 2880 C.F.M.

As near as could be measured. 1850 C.F.M. was coming in through the open windows and the balance of the air was leaking through the doors and crevices

Objectionable cold drafts near all windows were very noticeable to the occupants, also objectionable odors near toilet adjacent to elevator.

Test No. 11 is almost a duplicate of No. 10, the only difference being that a few windows were open and that the exhaust fans were running much more slowly, only 4050 C. F. M. being exhausted instead of 16,740, as in test No. 10. The suction of the fans at this speed was not great enough to cause a reversal of the natural air currents through the ventilators. The same remarks which were made about test No. 10 apply here also.

Test No. 12, March 7, 1917, 5th Floor.

All doors closed, 5 windows slightly open.
Outside weather conditions—Temp. 40½°F.
Relative humidity 65%.
Direction of wind—SW.
Velocity—17 miles per hour.
Time—

Exhaust Fans:

North exhaust fan, speed 572 R.P.M. velocity 1175.
Volume 8225 C.F.M.
South Fan, speed 572 R.P.M., velocity 1100, Volume 7700 C.F.M.

Globe Ventilators:

2 closed, 6 open.
No velocity in either direction indicated through the ventilators.
Average temperature of the room, 70 2/7°F.
Average relative humidity—28%.
Average CO_2.
Temp. of air discharged through exhaust fans—77°F.
Relative humidity of same, 20%.

The results of the above test indicated that the fans were exhausting 15,925 C.F.M. from the room, of which approximately 11,445 C.F.M was coming in through the open windows, the balance leaking in through cracks and crevices.

Objectionable cold drafts near all windows were very noticeable to the occupants, also objectionable odors near toilet adjacent to elevator.

The opening of several windows gave an inlet for the air, so that it was not compelled to come down through the ventilators, the suction of the fan being just sufficient to balance the pull of the ventilators, there being no motion through them in either direction. In other respects, the conditions observed were about the same as in tests Nos. 10 and 11.

These tests, Nos. 10, 11 and 12 each covered only a short period of time. It would be interesting to know how long the exhaust fan could be run before the incoming cold air lowered the temperature of the room to such a point as to cause marked physical discomfort to the occupants. The shortage of radiation on this floor makes the maintenance of a proper temperature inside in sub-zero weather impossible when the fans are running at full speed.

Test No. 13, March 12, 1917. Basement to 5th Floors Inclusive.

Windows on all floors partially open, all corridors open.

Outside weather conditions—Temperature 36.5°F.
Relative humidity—66%.
Direction of wind—E-NE.
Velocity 7 miles per hour.
Time—1:30 P.M. to 2:30 P.M.

Exhaust Fans:

Not running.

Globe Ventilators:

Six open—2 closed.
Average exhaust velocity through ventilators, 490-ft. per minute.
Total volume—9400 C.F.M.

Observations taken at each corridor door on each floor indicate the following results:

Room:	Velocity N. E. Door Feet per min.	Velocity S. W. Door Feet per min.	Total Volume Cu. Ft.	
Basement	—20	0	—540	
1st floor	—125	—85	—5670	— 105 C.F.M. per person
2nd floor	—215	—150	—9755	— 44.4 C.F.M. per person
3rd floor	—150	0	—4050	— 17.9 C.F.M. per person
			—20015	—20015 Average 32 C. F. M. per person.
4th floor	+165	+190	+9585	
5th floor	+200	+170	+9990	
				+19570

The following windows were open on the 4th floor, through all of which the air was going out:

North Wall—4 windows open. 6 in. x 4 ft. each
East Wall—2 windows open. 6 in. x 4 ft. each
South Wall—2 windows open. 24 in. x 3 ft. each
West Wall—3 windows open. 6 in. x 4 ft. each

CO_2 tests, 5th floor, taken at frequent intervals indicated the following:

1:30 P.M.—fans not running, 30 min. after 1st test.

North-east Stair Hall CO_2	South-west Stair Hall CO_2
5.6	5.5
5.4	5.3
5.5	4.9

NOTE:

(—) Indicated air movement from room into halls.

(+) Indicated air movement from hall into rooms.

This test is interesting because it shows so closely the well-known effect of air pressures around tall buildings, showing a strong pressure inward in the lower stories, a neutral zone, and a strong pressure outward in the upper stories. The effect of the opening of windows is very noticeable as the 12 sq. ft.—open window area on the fourth floor caused it to have nearly as great an air movement as the fifth floor, with its presumably more efficient roof ventilators.

The quantity of air moved throughout the building was quite large, averaging 32 cu. ft. per occupant—per minute. The quality of that portion of it which entered the fifth floor from the stair hall was not especially good, as the CO_2 contents averaged 5.36 whereas the outside CO_2 probably was not over 4 points, indicating that some contamination of the air had taken place. As there was only a comparatively small number of employees on this floor (81, each having 2000 cu. ft. of air space) the CO_2 probably rose only slightly higher. Had this floor been a crowded one, such as the second or third with over 200 employees, the condition of the air entering the rooms as it did with an initial contamination, probably would have become very bad before it escaped by the fans or ventilators.

Test No. 14, March 12, 1917. Basement to 5th Floors Inclusive.

Test No. 12 was repeated with all windows on the 4th floor closed, fans not running, giving results as follows: (see page 40).

Closing the windows on the fourth floor seems to have had three effects: First.—the volume of air moved throughout the building was cut down about 4000 C. F. M.; second, the neutral zone shifted so as to place the third floor in the upper, or outward pressure, portion of the building instead of in the lower, as in test No. 13: and third—a surprising reduction of over 7000 C. F. M. in the amount of air going to the fourth floor took place, the amount going to the fifth floor increasing at the same time.

The large part played by the open windows in this and the 13th test, shows the undesirability of depending on them for a continuous supply of air.

The considerable volume of air going to the fifth floor shows the strong draft created by the ventilators, which pulled 80% of the air coming into the building on the lower floors, up to the top, leaving the third and fourth floors with a marked deficiency of air supply. Thus, the ventilators were a help to the ventilation of the fifth floor, but a detriment to the ventilation of the third and fourth floors.

Room:	Velocity N. E. Door Feet per min.	Velocity S. W. Door Feet per min.	Total Volume Cu.Ft.	
Basement	0	0	0	
1st floor	—150	—120	—7300	
2nd floor	—215	—130	—9315	
				—16615
3rd floor	0	50	1350	
4th floor	40	50	2430	
5th floor	250	195	12015	
				+15795

Average 26 C. F. M. per person.

Test No. 15.

The above tests were then repeated with 4th floor windows open, as in test No. 13, and exhaust fans running, as follows:

North exhaust fan,	speed	670 R.P.M.
Velocity		1425 F.P.M.
Volume		9975 C.F.M.
South Fan,	speed	600 R.P.M.
Velocity		1380 F.P.M.
Volume		9660 C.F.M.

Globe Ventilators:

6 Ventilators open.
Average velocity 320 F.P.M.
Volume 6144 cu. ft.
Total 25779 cu. ft.

Room:	Velocity N. E. Door Feet per min.	Velocity S. W. Door Feet per min.	Total Volume Cu.Ft.	
Basement	—200	0	—540	
1st Floor	—270	—210	—12960	54 persons—240 C.F.M. each
2nd Floor	—240	—100	—9180	219 persons— 42 C.F.M. each
3rd Floor	—135	—10	—3915	226 persons— 17.3 C.F.M. each
			—26595	
4th Floor	100	175	7425	29 persons— 25.6 C.F.M. each
5th Floor	490	460	25650	81 persons—316 C.F.M. each
			+33075	

Total persons..................609
Total air movement..........33075 C.F.M.
Average per person............54.5 C.F.M.

4:00 P.M. Fans running full speed 1½ hrs. after third test.

Northeast stair hall	Southwest stair hall
CO_2	CO_2
4.6	4.9
5.0	4.7
5.4	5.0

CO_2
Northwest corner of room..........5.7
Center of room......................6.8
Southeast corner of room..........5.9
North exhaust fan..................5.0—6.2
South exhaust fan..................5.9

The use of the exhaust fans naturally caused a general increase in the amount of air moved. The almost exact correspondence between the amount of air passing through the fans and ventilators on the fifth floor (25779) with the amount entering the room through the stair hall doors (25650) indicates that the suction of the fans and ventilators was just sufficient to balance the natural outward pressure of the air through and around the windows.

The ratio of window area to floor area (1 to 7.5) is such that taken in connection with the shape of the building and the arrangement of windows on all four sides, a very well lighted building results.

The work done in this shop is light manufacturing, and there is nothing in the processes carried on which would cause especial contamination of the air. Some excess radiation has been provided to heat the incoming air, but the amount of this excess is only sufficient to warm about 7,000 C.F.M. in —10° weather. Adding the amount of heat radiated by the occupants brings the total amount of cold air which can be introduced, up to about 10,000

Data

	2nd	3rd	5th
Ratio window area to floor area	1 to 7.56	1 to 7.56	1 to 4.65
Ratio window area to cu. contents	1 to 75.6	1 to 77	1 to 46.5
C. F M. air per occupant Tests 1 to 8	26.2	41.6	51.9
C. F. M. air per occupant. (Test No. 13, corridor doors open, fans not running)		32	
Ditto—test No. 14		26	
C. F. M. air per occupant (test 15, exhaust fan running)		54.5	
Air space per occupant, cu. ft.	735	715	2000
No. occupants	219	226	61
Contents, cu. ft.	159000	162000	162000
Floor area, sq. ft.	15900	16200	16200
Window area, sq. ft.	2100	2100	3500

C.F.M., whereas over 18,000 C.F.M. is required, leaving a deficiency of about 50% of air supply. Naturally the consequence is that the occupants cannot bear to have the exhaust fans run in cold weather.

It is very doubtful whether equal ventilation could ever be obtained on all floors with this system of ventilation—that is, exhaust fans on the top floor and all stairhall doors open—even if an adequate amount of radiation were provided to warm the air. The lower floors, especially the first and second, would undoubtedly be well ventilated, and would receive an ample amount of air at all times. The air in the floors near the neutral zone would be stagnant and the top, or fifth floor would very seldom receive anything except what might be termed "second hand" air, as its entire supply must come through the windows on one of the lower floors, pass over that floor and up the stairhall to the fifth floor, becoming more or less contaminated on the way. Under the conditions of this test, viz., a small number of employees on the top floor, this is not a very serious matter, but it certainly is not a very desirable condition in any case, as a ventilating system should provide each occupant of the space ventilated with an adequate supply of uncontaminated air.

The desirability of separate mechanical ventilation of toilets is especially great with a ventilating system of this character, as without it the suction effect of the fans and ventilators tends to draw toilet room air into the main room, whereas the air current should be in the opposite direction.

Conclusions of Tests.

It is evident from these tests, that:

A. In a building having five or more stories, a lively air movement can usually be obtained inward through the windows of the lower floors and outward through the windows of the upper floors.

B. There will necessarily be a neutral story at some point where the difference in pressure which causes the air movement, will equalize, and here the ventilation will be deficient.

C. If the windows are on all four sides of the building, and are operated properly, the distribution of fresh air may be so efficient as to permit of a material reduction in its volume.

D. The higher the building, the greater the difference in pressures causing air movement will be, provided the stairways, elevator shafts, etc., are open to the various floors.

E. The volume of air admitted in the lower stories must be so large in proportion to its contamination that it shall be suitable for ventilating purposes in the upper stories.

It is apparent that with such an

arrangement as described here, the manipulation of the windows in proper relation to the outside temperature and weather conditions is essential. The area of intake openings in any floor must be gauged in proper proportion to the relative position of that floor in the building, since, for instance, we find the first floor normally under a greater inward pressure than the second floor, and the third floor almost neutral.

It must be recognized that in cold weather, owing to the drafts caused by open windows, it is probable that the windows will be kept closed. If excess radiation is provided to care for the air used in creating ventilation, it is our belief that the entering air should be deflected through or over the radiation, or at least deflected so that the direct cold drafts cannot strike the occupants, and so that the rain and snow cannot enter.

In this connection, in considering the manipulation of windows in such a building as this for summer ventilation, where fly screens are provided, these must cover the entire window area, so that all of the windows may be opened from the top as well as from the bottom.

It is very important that the air conditions in a building of this character should be under the supervision of an intelligent person whose duty is to see that the windows and doors are open in such a manner as to allow the proper circulation of fresh air without causing objectionable drafts at any one point, and to see that the exhaust fans are operated when the building is occupied.

The studies made by the Chicago Commission on ventilation of the plants of the John Gorman Co. and the Paris Garter Co. were intended to develop in a measure, fair, comparative examples of the conditions of window ventilated buildings. The Gorman plant has windows on two sides only and comprises the fourth floor of a seven-story building. It is so arranged, apparently, that its position in the building has no special effect on it. The Paris Garter plant, on the other hand, is a five-story building; and the influence of the various floors on conditions in each other, is the most noticeable phenomenon observed. The following is a tabulation of some of the data.

No. Occupants	Space per Occup. cu. ft.	Ratio Window to floor	Ratio Window to C. C.	C. F. M. per Occupant	Temp. Deg. F.	Hum. per cent	Dust.	Bact.	Co.$_2$	Temp. Deg. F.	Wind. Veloc miles per hour.
GORMAN											
110	650	1-11.5	1-120	93.2	70 deg.	43.5	32866	13.5	10.4	44.6deg.	9.7
PARIS GARTER—3rd FLOOR											
219	735	1-77	1-77	26.2	69.75	28.7	4175	3.02	8.15	11.5	13.1

The amount of air handled per unit of time per occupant in the Gorman factory, it will be noted, was over three times that handled at the Paris Garter Factory. However, despite this, the latter shows superior air conditions. These are, of course, due to:

A. The fact that the Paris factory had no manufacturing processes under way which resulted in objectionable products of combustion of manufacture.

B. The fact that the latter had windows on all sides, so that wind movement could be utilized at all times.

C. The continuous air movement due to the exhaust fans, ventilators and the height of the Paris factory.

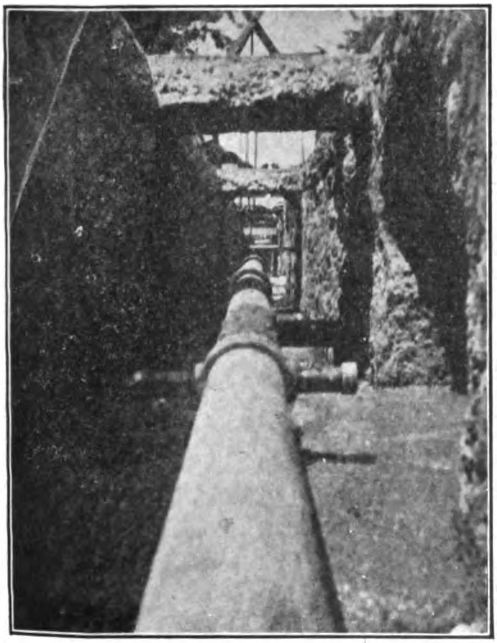
D. The fact that the Paris factory had fewer occupants per units, and much more sunshine.

In tests of such plants, having no particular control of window manipulation, our observations must be understood as applying to the specific time of test only and not to all weather conditions. The conditions prevailing, however, at the time of this test were a fair average for the heating season. Had the weather been colder at the Gorman plant, or had there been no breeze, very much less air would surely have been provided. Had the day been warmer when the Paris Garter plant was tested, doubtless much more air movement would have been in effect. Window ventilation as installed in these plants does not in either case insure a continuous, dependable, and satisfactory condition.

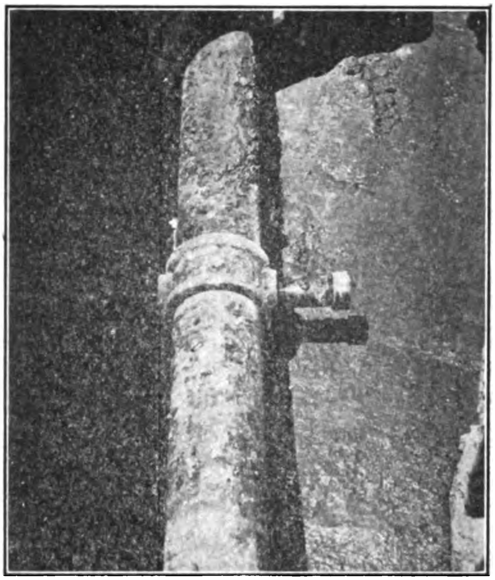
◆

Use of Cast-Iron Returns in District Heating Work.

The accompanying views show a section of the installation of cast-iron return mains in the Saginaw (Mich.) central station steam heating system. Ths is one of the first localities in which cast-iron pipe has been used for such purposes and considerable interest attaches to its serviceability. There are 3748 lin. feet of cast-iron pipe installed as return mains and 3359 ft. of services. The mains vary in size from 6-in. down to 3 in. with 2-in. services, while the greater part of the main is 6 in. The main is of variator construction and is not insulated in any form.



6-IN. CAST-IRON RETURN MAIN AT SAGINAW, MICH.



TYPICAL 2-IN. SERVICE CONNECTION TO CAST-IRON RETURN MAIN, SAGINAW, MICH.

After three years' service the company states that the main shows no sign of corrosion. It seems that a greater part of the city of Saginaw was built upon land which was formerly a swamp. The result has been that in the Spring of the year there is abnormally high water and after it subsides several breaks have been found, although these were mostly confined to services which are constructed of 2-in. Universal cast-iron pipe in 6-ft. lengths. As a general rule, this pipe broke at the joint which was bolted together.

In the Spring of 1916 there was exceptionally high water in Saginaw and after it receded seven breaks were found in the return line, one in the main and six at the services. The return system was not valved off at that time and the company experienced great difficulty in finding these leaks. However, after weeks of testing and experimenting, city water was turned into the mains which at once showed up all the leaks.

The ony trouble experienced with the use of cast-iron pipe seems to lie in the condition of the ground which varies considerably throughout the year. The use of the 2-in. cast-iron pipe when installing services has been discontinued and service connections are now made of wrought-iron pipe. No change, however, has been made in the mains themselves.

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A. S.. ARMAGNAC.....................*President*
GUSTAVE PETERSEN....*Secretary and Treasurer*

A. S. ARMAGNAC, Editor
GUSTAVE PETERSEN, Business Manager
HAROLD L. ALT, Contributing Editor

European Representative:
W. G. HOLLINWORTH, 304 High Holborn
London, W. C.

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EVERYONE is aware of the fact that vast changes in the economic life of the nations at war are to follow the conclusion of peace. We are warned that we must gird ourselves for the coming commercial struggle. Each individual industry must take up the challenge and place itself in readiness to meet the new era.

What is the heating industry doing to put its house in order and what steps are necessary to that end? A possible answer is suggested by what has happened in the gas industry, amounting to nothing less than the amalgamation of the entire industry into one organization—the American Gas Association. This action, which has just been consummated, "is the final outcome of a growing conviction among executives in control of gas companies and gas appliance and apparatus manufacturers that the best interests of the business would be served with one big national gas organization representing all the various phases of the industry, in place of the present association."

It is worth while to note just what has been accomplished by this amalgamation. Among other things, "there is now adequate financial backing, widespread membership and well-co-ordinated undertakings—an organization which will be in a position to gather and disseminate . . . . accurate information on all matters relating to the industry. It will also establish a closer co-operation between companies and manufacturers . . . . and afford opportunity for the solving of the many particular problems of the latter."

As to the various branches there are provisions for two classes of membership—company membership and active individual membership. The association is also divided into five sections: accounting, commercial, manufacturers, natural gas, and technical. Individuals will have the privilege of joining any one or more of the five sections. The dues are arranged to enable any individual to take an active part in any one or all of the sections, at an expense which will not be prohibitive.

At the present time the heating industry is confronted with such important projects as the establishment of a testing laboratory and the furtherance, in a highly practical way, of fuel conservation. Either one of these movements, if successfully carried out, may establish the pre-eminence of American heating practice. Has the time come, then, to go after these objects in a big way, in a way that will represent the best thought and enlist the combined practical support of all the interests involved—manufacturer, contractor and engineer?

◆

IT is a significant thing that the manufacturers and heating contractors, together with the plumbers, represented by their national associations, have just taken what amounts to the first step in the history of the allied organizations towards unity. The "Building Bigger Business" campaign is a great co-operative movement. Is there any reason why the close relations thus established should not be made permanent?

NATIONAL DISTRICT NDHA HEATING ASSOCIATION

President George W. Martin on The Outlook in The Central Station Heating Industry

As everyone connected with the heating industry knows, operating companies have been facing extraordinary conditions of increased labor and fuel costs and have been forced to appeal to the Public Service Commissions of the various States for relief. It is encouraging to report that the Commissions have, I believe, in every case, granted some relief and have at least been convinced that district heating companies are entitled to consideration in the matter of a fair return for the service necessary for the health and comfort of the customers.

As I have already written to the members of the National District Heating Association, the situation in some respects has its advantages. The member companies in the past have been seemingly diffident in appealing to the Public Service Commissions for advances in rates. The high operating costs have left no other course open, however. Doubtless before the war's end several further advances in rates will have to be made, and with the Commission falling in with the views of the member companies, as they now seem to be doing, the burden of low rates will no longer handicap the industry.

GEORGE W. MARTIN,
President, National District Heating Association.

The shortage of coal for domestic purposes has brought to our member companies a large number of applications for service and has undoubtedly convinced many doubters of the desirability of district heating service. When the companies are in a position to make extensions without prohibitive costs, I look for a large increase in the district heating business.

It may interest the readers of THE HEATING AND VENTILATING MAGAZINE to know what the standing committees of the Association are doing, especially in view of the fact that no regular convention will be held this year; in its place a meeting of the Executive Committee and Committee Chairmen will be held, probably at Cedar Point, Ohio, for two days, beginning July 8. A general invitation will probably be extended to such of our members as care to attend, but, as already indicated, no formal convention will be held.

Of the standing committees, perhaps an outline of the work of six will be of interest to your readers.

The Station Operating Committee will report boiler-room tests in several of the member companies plants. The question of feed-water treatment will also be discussed and a summary presented of what might have been accomplished during the past year in improving boiler-room operation.

The Underground Construction Committee has distributed questionnaires dealing largely with practice in building manholes and expects to have considerable information regarding this feature of construction.

The Meter Committee is attempting to establish by test the actual capacity of each size of the most prominent types of steam traps. In addition to the work on traps, the Committee will as usual discuss any new developments in either condensation meters or steam flow meters.

The Advancement Committee, appointed at the last Convention, has been accumulating data relative to successful heating plants, including, among other things, the gross revenue of the detailed operating expenses of a successful combination property. The report will include the detailed study of the division of fuel in combination plants, describing and explaining various methods of this distribution. The important question of arranging rates as near as possible in accordance with the increase in operating costs will also receive attention.

The Educational Committee is giving considerable attention among other things to the matter of a standard rule for determining the proper amount of radiation for a building. One of the chief difficulties in making a standard rule for this purpose is that different authorities differ widely on heating losses through various kinds of construction material, but it is hoped some rule may be adopted which will be satisfactory at least to all our member companies, so that comparative data submitted may be compared on the same basis.

The Accounting Committee is preparing a report on standard system of accounts for district heating companies, which should be of great value to the member companies of our Association.

Another matter which is receiving attention is a suggested contract for hot-water district heating utilities, submitted to the Indiana Public Service Commission by the Bureau of Standards at Washington, D. C. A conference was held recently at Indianapolis at which representatives of thirteen member companies were present. After considerable discussion a committee was appointed to submit a report to the Educational Committee of our Association, which will in turn transmit a report to the Bureau of Standards.

The foregoing outline will, I think, indicate that the Association is living up to its reputation for active committee work and, in view of the fact that no convention is to be held this year, it is hoped that the committee reports will be of even greater value than those of the last year.

George W. Martin,
President, National District Heating Association.

Modern Practice in Vapor Heating

II

I.—The Adsco System

Editor's Note—*For the purpose of this series of articles, a vapor, vacuum, vapor-vacuum, vacuum-vapor, atmospheric, modulated or thermograde system of heating will be considered as any system in which the steam pressure ordinarily carried is practically at atmosphere or slightly below or in which the returns are open to the atmosphere and where no pump or other positive mechanical device is employed to pull back the returns.*

The first special system to be considered in this series is the "Adsco" system of atmospheric steam heating which has been developed and perfected by the American District Steam Co., of North Tonawanda, N. Y. This system was one of the first of the many so-called "vapor" systems to be evolved and as such has had the ample opportunity of a long period of years to be perfected.

REQUIREMENTS

Among some of the features which this system requires for its successful operation may be mentioned

A special reducing valve where district heating is used.

A special damper regulator where a boiler plant furnishes the steam supply.

Special gauges for registering in ounces instead of pounds.

An air-separating receiver for district heating connection.

An air vent line in one or more locations run through the roof.

A special safety valve (desirable) set to blow at 15 oz.

A special graduated control valve on each radiator.

The control valve must suit the size of radiator upon which it is installed otherwise proper control will not be secured.

As only 80% of the radiator surface is used for condensing steam the radiator surface must be increased 20% above that actually required to heat the building.

Hot water radiation must be used.

Indirect, direct-indirect, and hot blast radiation must not be connected to this system but should be piped according to usual standard methods.

TYPICAL SYSTEMS.

The piping system as designed to suit central heating conditions is shown in the typical layout given in Fig. 1 and the connections where a boiler is used on the premises is given in Fig. 2. The operation of the system is briefly outlined in the following description, the steam being supplied either from a common steam boiler or from district street mains through a special reducing valve.

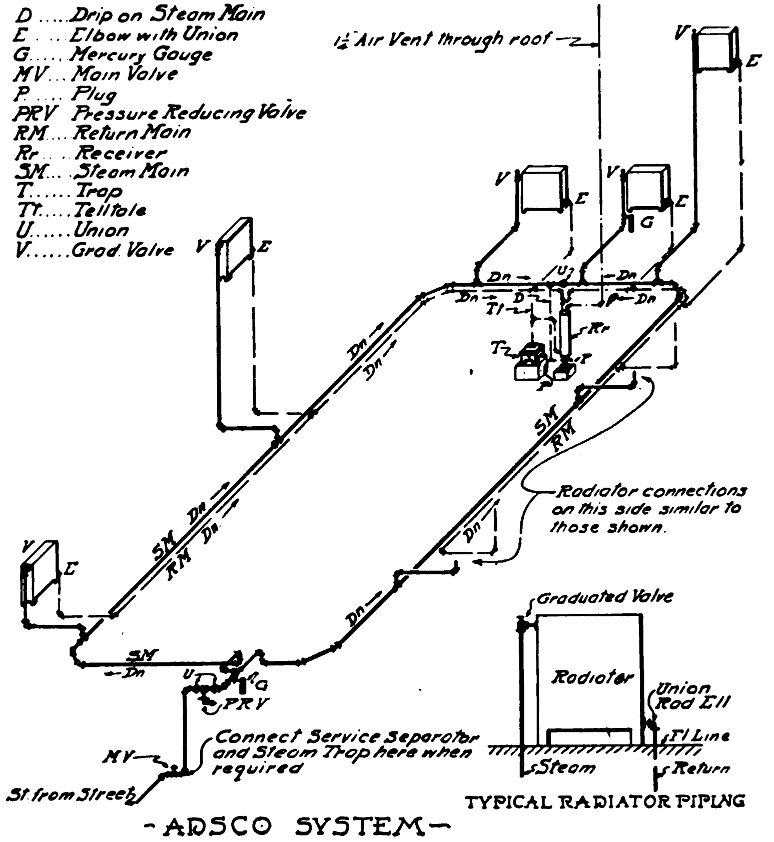


FIG. 1.—TYPICAL LAYOUT OF ADSCO SYSTEM TO SUIT CENTRAL HEATING CONDITIONS.

The steam when coming from the street is usually supplied at a pressure carrying from 2 to 10 lbs. and the special reducing valve is arranged to reduce and maintain on the system a pressure sufficient to give 5 oz. at the radiator valves. The sizes of reducing valve recommended are two pipe sizes less than the diameter of the low-pressure main; thus, a building requiring a 6-in. low pressure main would be supplied by a 4-in. street connection and 4-in., or 4 x 6-in., reducing valve. The schedule of sizes recommended for 2 to 15 lbs. street pressure is as follows:

Sq. Ft. of Radiation	Size of Reducing Valve in. Diam.
0 to 200	1 x 1½
200 to 300	1¼ x 2
300 to 600	1½ x 2½
600 to 900	2 x 3
900 to 1400	2½ x 3½
1400 to 2200	3 x 4
2200 to 2800	3 x 5
2800 to 3600	4 x 5
3600 to 6000	4 x 6
6000 to 8500	5 x 7
8500 to 11,000	5 x 8

Straight valves with both inlet and outlet of the small size can also be used if desired.

If a steam boiler is to be used its load will only be 80% of the total radiation plus the steam main loss (not over 10%) making the total required boiler capacity 90% of the total radiation; to control the boiler pressure a special regulator is used, this being illustrated in Fig. 3. It consists of a weighted float which rises on the surface of the water inside of the vented regulator. This float is connected to a lever operating the draft and check dampers. The creation of any pressure in the boiler backs the water into the regulator and raises its water line, thus operating the float. The safety valve used on the boiler is set to relieve, at 15 oz. pressure but can readily be adjusted down to 11 oz. if desired; its tapping is 1¼-in. size.

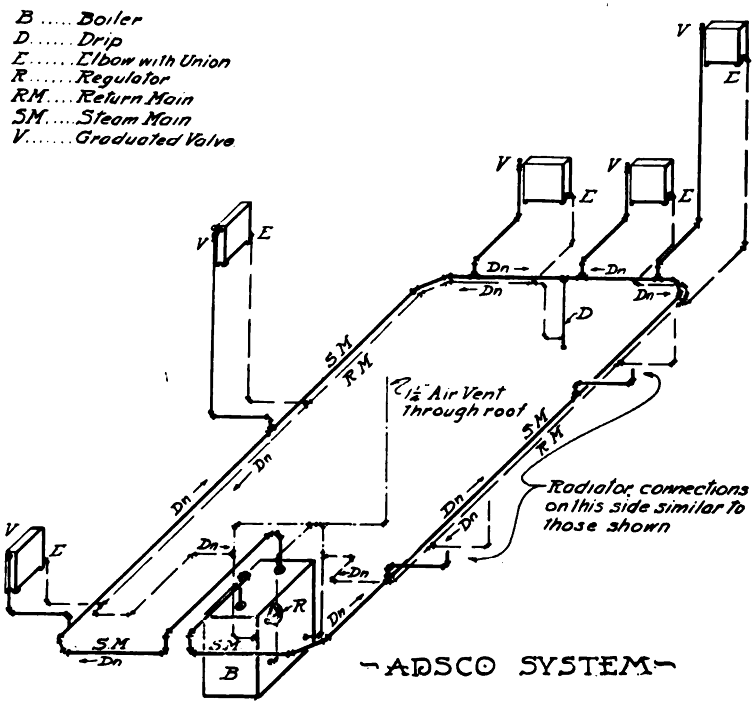


FIG. 2—ARRANGEMENT OF ADSCO SYSTEM WHERE BOILER IS USED ON PREMISES.

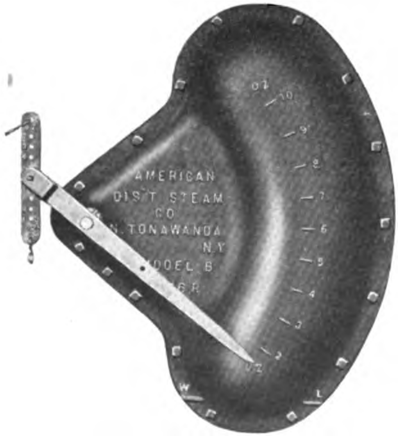


FIG. 3—SPECIAL BOILER PRESSURE REGULATOR.

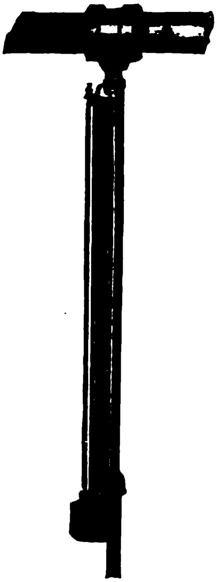
To accurately register the small amounts of pressure generated either the water gauge illustrated in Fig. 4 or the mercury gauge shown in Fig. 5 may be used. The water gauge is generally used on district heating systems but the mercury gauge may be applied to either.

The steam main in the basement should be arranged so as to secure the best circulation and with the minimum drop in pressure, drips being located where required either drained back to the boiler through a separate line or connected into the return line through 30-in. water seals. In all changes of direction on the main, bends, long sweep or 45° fittings should be used; pipe should be well reamed and clear; in fact everything should be done to promote the flow of steam with as little loss of pressure as possible and the size of the steam main should at no point be decreased below 1½ in.

The steam is carried in the steam main up to a point within four feet of the graduated radiator valve; at this point the radiator branch is reduced to ¾-in. in size as *all* radiator valves have ¾-in. thread. The interior construction of the valve is illustrated in Fig. 5 and it is one of the most important factors of the system. As designed it is made to supply a given radiator with 80% of the amount of steam it can condense under ordinary operating conditions and with 5 oz. of steam pressure on the supply pipe to the valve; the proper size of radiator is stamped on the valve top and the valves are made with stampings in multiples of 5 from 10 sq. ft. to 200 sq. ft.; for this reason the size of the radiator must always be specified in ordering valves.

The radiators used are common cast-iron surface of water pattern tapped ¾-in. top and bottom opposite ends. No air valves are used and the return connection consists of simply a union radiator ell which is connected into the return line.

The return lines are under no pressure whatsoever, and serve to convey the water of condensation, together with the air, back to the point where the air separation takes place. In systems supplied from a street main and provided with a condensation meter a receiver is used, this being illustrated in Fig. 6. Such receivers have a minimum water depth of 30-in. and the outlet pipe to the meter carried up to a height 8-in. below the top. In Fig. 6, A indicates air vent pipe; B, return lines and C the outlet to the meter. The diameter of these receivers is recommended to be as follows:



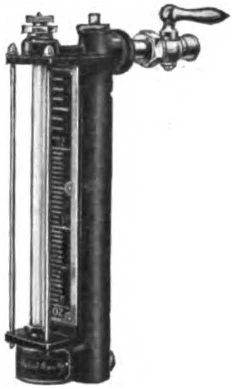


FIG. 4—WATER GAUGE. FIG. 5—MERCURY GAUGE.

Radiation. Sq. Ft.	Diameter of Receiver In.
600	5
1200	6
2000	8
6000	10
12000	12
20000	16

The air pipe is usually made 1¼-in. which is plenty large enough for any ordinary size system; more vents may be used on larger systems and with a boiler supply no receiver is used. The air lines should be run at least 12 to 15 ft. above the water-line, terminating outside the building wall or carried up through the roof. The return either passes through the condensation meter or (in a boiler plant) drops down into the boiler by gravity. In both cases the return line is vented to the atmosphere and carries no pressure; it is not even necessary to cover this line unless thought desirable.

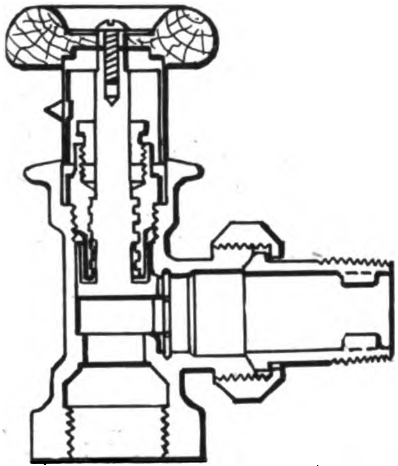


FIG. 6—CONSTRUCTION OF ADSCO VALVE.

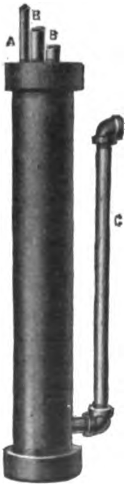


FIG 7.—PIPE RECEIVER.

METHOD OF OPERATION

Steam finds its way through the steam main and branches up to the radiator valves which are turned on to the desired degree, a three-quarter turn serving to open or close the valve completely. The valve is designed so that the steam coming into the radiator through the valve, with 5 oz. pressure back of the valve, enters with just sufficient velocity to fill the radiator to the degree registered by the valve dial. If this is set at, say, ⅓ then the steam fills ⅓ of 80% of the radiator. Owing to the fact that steam is lighter than air it is usually the top portion of the radiator which is heated, the return and air which the steam displaces finding their way down and out through the return ell. The air and condensation then flow back through the return line to the point of air separation where the air leaves the system through the open vent pipe while the returns go to the meter or back to the boiler by gravity.

LEGAL DECISIONS

Surcharge for Heating Service On Account of Increased Cost of Fuel.

The Brownville Electric Light & Power Company petitioned the Indiana Public Service Commission for authority to add a temporary surcharge to all bills for hot-water heating service. It appeared that while the electric department of the company's business was profitable, its rate of 12 cents per square foot of radiation per season is not sufficient to return to the company on its hot-water heating service, operating expenses and taxes under the abnormal prices existing for coal and the advances in the cost of labor, supplies, and other materials, all of which are attributable to a war era and are looked upon as being temporary. The petitioner's rate for hot-water heating is the lowest for such service in the State of Indiana. It has been made possible by the petitioner's ability to obtain coal at $1 a ton; and there has been an advance of 50 per cent in its coal contract. The city protested to the surcharge on account of the increased cost of heat furnished to its schools and other public buildings, and alleged that the cost of such service in public buildings would be greater than would be the cost of heating these buildings by individual plants; and that, on the other hand, the cost of installing individual plants at this time is extraordinarily high. The Commission did not consider this a valid objection to the proposed relief and approved a surcharge of 5½ cents per square foot of radiation for the heating season of 1917-18. At the same time the Indiana Commission made the following orders allowing surcharges for heating service: Princeton Light & Power Co. Hot-water heating; surcharge of 17 cents per square foot of radiation. Central Indiana Lighting Co. Hot-water heating; surcharge of 7 cents. Interstate Public Service Co. Hot-water heating; surcharge of 5 cents and 7 cents. Indiana R. & Light Co. Steam heating; surcharge of 30% of bill allowed.

Apportionment of Expenses Between Electric and Heating Departments.

In a rate investigation the Colorado Commission holds that the apportionment of operating expenses as between the electric and steam heating departments of a public utility on the basis of coal consumption in some cases and investment in others was held proper. An apportionment of commercial expense to the gas, electric and steam heating departments of a utility on the basis of the number of consumers in these departments, was held proper. An apportionment of valuation expense, accidents and damages, legal expense in connection with damages, interest on consumers' deposits, rent, and county and State taxes between these three departments on the basis of gross revenue was held proper; and an apportionment of inventory and appraisal costs between the departments on the basis of their appraised value, and of the cost of conducting rate hearings on the basis of gross revenue, were held proper. Re Colorado Springs Light, Heat & Power Co.

Combined Electric and Heating Plant—Cost of Coal and Heating Rates.

The Illinois Public Utilities Commission holds that a utility that has developed a heating service through the operation for many years of a combined electric and heating plant should not be relieved of its obligation to furnish heating service upon building a separate electric plant to effect economies in the generation of electricity, although the heating department has since been operated at a loss and the distribution system is in need of extensive repairs. The heating service should be continued at a rate that will return sufficient revenues to meet reasonable operating expenses, plus a reasonable depreciation and a reasonable return on the additional investment necessary to restore the plant to its former capacity and a return on the junk value of the existing plant. The change in the method of operating which has benefited the electric department and has not been shared by the consumers should be reflected to some extent by reductions in the earnings to which the heat department might otherwise be entitled. The utility, Alton Gas & Electric Company, operates its combined electric and heating plant merely because of the existing heating business, and procures most of its current from other sources. The Commission holds that the company should credit the heating department for current generated at the combined plant on a basis of cost rather than on a basis of worth, by taking the average of the actual cost of production at the heating plant with the cost of electricity procured elsewhere, instead of the average cost of procuring the current elsewhere. Owing to the increasing price of coal, the coal prices during the season 1915-16 were taken as the basis for determining steam heating rates with provision made for a variable rate differential, both up and down, predicated on the future average cost of coal to the company.

Discrimination in Rates.

The Ohio Supreme Court holds that municipalities of the State are authorized to establish, maintain and operate lighting, power and heating plants and furnish the municipality and the inhabitants thereof with light, power and heat. The powers thus conferred are proprietary in their character, and in the management and operation of such plant municipal officials are permitted wide discretion. Courts are without authority to interfere therewith upon complaint merely that the capacity of the plant is overtaxed and streets of the municipality are insufficiently lighted by means of furnishing current to private consumers, and that the rates charged for current are inadequate to meet the cost of production and transmission thereof. But where the council of any such municipality fails to adopt and use a system or schedule of rates for current furnished to private consumers as contemplated by section 3616 Ohio General Code, but leaves the matter of rates to the administrative officers of the municipality, who arbitrarily fix and determine the rates in each case, and in so doing unjustly discriminate between citizens in the matter of rates and service, such action constitutes an abuse of corporate power which may be restrained by the court upon suit instituted by the city solicitor, or by a taxpayer if the city solicitor refuses upon written request to institute suit,—Butler v. Karb, 117 N. E., 953.

Steam Heating—Values, Return and Minimum Bills.

The Illinois Public Utilities Commission holds, Kennedy v. De Kalb-Sycamore Electric Co., that the fair present value of property used and useful in rendering public service rather than the cost of such property must be taken as the rate-making value. In apportioning the value of property used in the steam-heating service of a utility furnishing electricity and steam heat in two cities and interurban railway service between these two cities, consideration must be given to the saving effected by the utility's present method of operation in generating all the electricity in one city, rather than operating combined electric and steam-heating plants in each city as formerly, thus making available large quantities of exhaust steam for heating purposes in the city served by the combined plant, since the entire advantage of this mode of operation should not be enjoyed solely by the heat consumers in the latter city. A return of 7% was allowed as a fair return on the fair value of a steam-heating plant. It was held that a minimum bill should embrace, in addition to the fixed consumer expense, the average cost of the commodity consumed under the minimum quantity. The minimum bill was fixed at $3 months of heating.

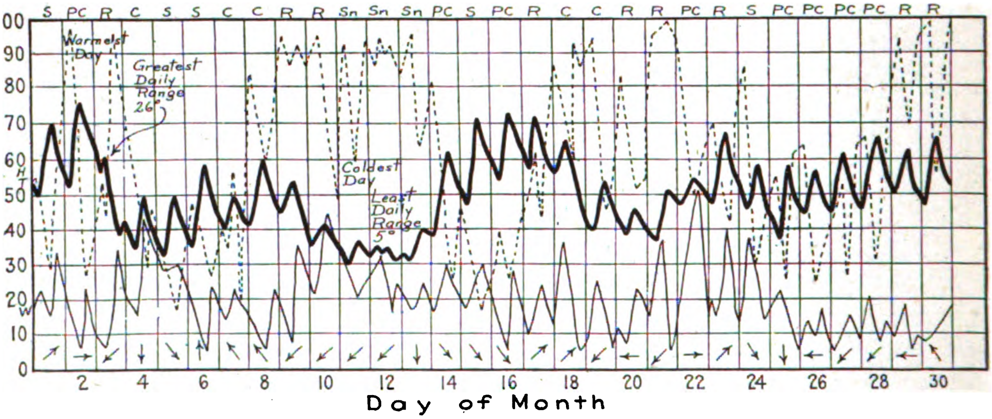
Meter Rates Substituted for Flat Rates.

The Wisconsin Railroad Commission has granted an application of the Milwaukee Electric Railway & Light Company for authority to discontinue flat rates for heating service. It considered that complete metering of the heating system is the only means of eliminating a condition of actual discrimination among the customers of the company.

The Illinois Public Utilities Commission has permitted the Central Illinois Light Company to withdraw a flat rate for steam heating and to put all consumers on a meter rate schedule where it appeared that discrimination as to the amount of the rates existed in favor of the flat-rate consumer. It considers that prior to the substitution of meter rates for flat rates for steam heating in any case, sufficient notice should be given to the flat-rate consumers to permit them to install private heating plants should they desire to do so.

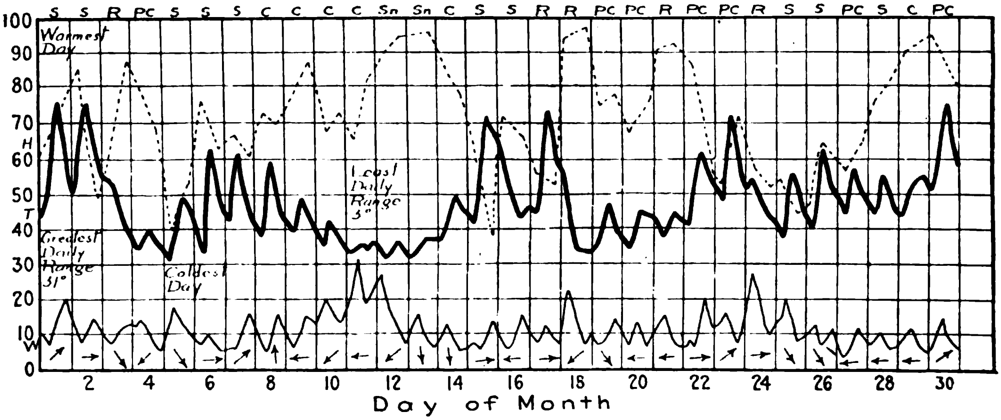
The Weather for April, 1918

	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest temperature, degrees F.	76	76	74	76	81
Date of highest temperature	2	1	2	16	16
Lowest temperature, degrees F.	30	31	27	29	30
Date of lowest temperature	11	5	10	9	10
Greatest daily range, degrees F.	26	31	30	24	30
Date of greatest daily range	3	1	15	22	2
Least daily range, degrees F.	5	3	5	4	4
Date of least daily range	12	11	20	11	25
Mean temperature for month, degrees F.	49.8	48	49	44	51.2
Normal mean temp. for month, degrees F.	48.1	45.3	51	45.9	56.1
Total rainfall, in.	3.78	3.08	2.27	3.41	7.09
Total snowfall, in.	2.60	4.2	7.1	Trace	Trace
Normal precipitation, this month, in.	3.30	3.55	2.9	2.88	3.52
Total wind movement, miles	11142	7700	9169	10474	10144
Average hourly wind velocity, miles	15.5	10.7	12.7	14.5	14.1
Prevailing direction of wind	N. E.	E.	N. W.	N. E.	N. E.
Number of clear days	5	11	4	9	7
Number of partly cloudy days	10	9	3	7	12
Number of cloudy days	15	10	23	14	11
Number of days on which rain fell	7	6	15	18	15
Number of days on which snow fell	3	2	2	—	—
Snow on ground at end of month, in.	None	None	None	None	None

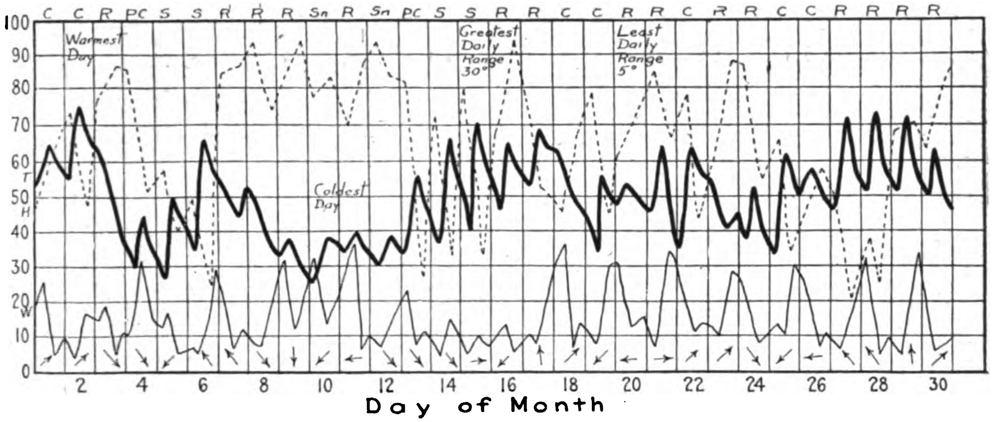


RECORD OF THE WEATHER IN NEW YORK FOR APRIL, 1918.

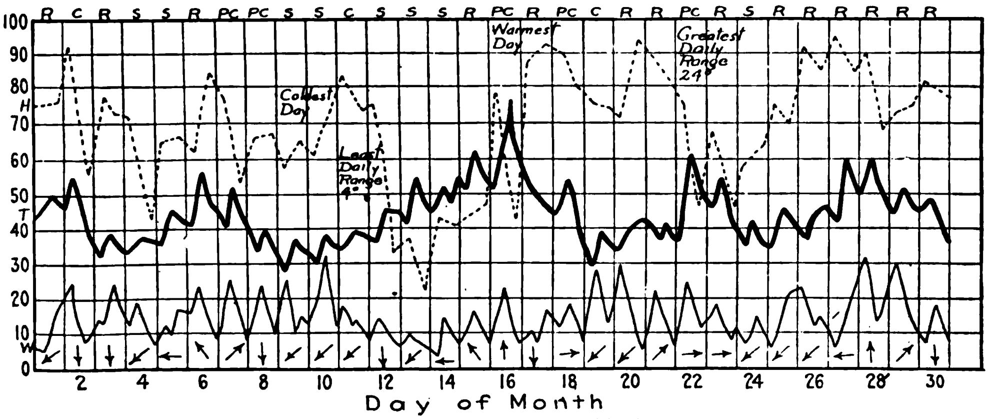
(Hourly Observations of the Relative Humidity Are Recorded on This Chart.)



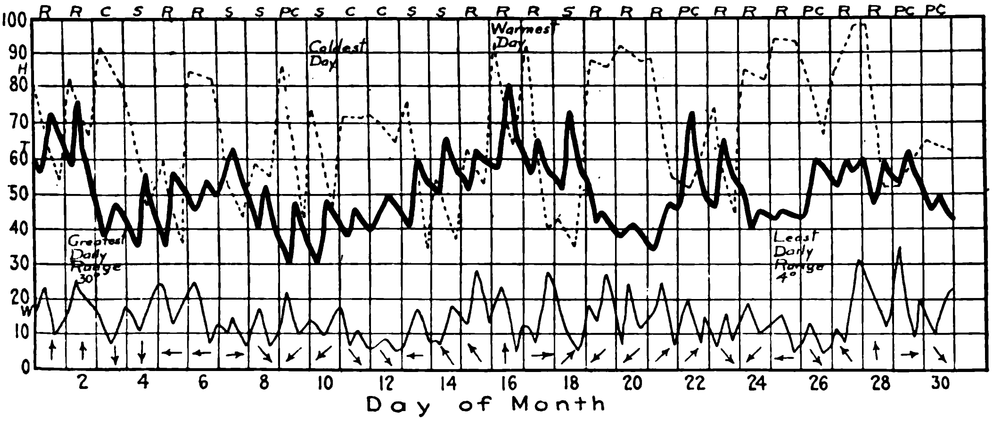
RECORD OF THE WEATHER IN BOSTON FOR APRIL, 1918.



RECORD OF THE WEATHER IN PITTSBURGH FOR APRIL, 1918.



RECORD OF THE WEATHER IN CHICAGO FOR APRIL, 1918.



RECORD OF THE WEATHER IN ST. LOUIS FOR APRIL, 1918.

Plotted from records especially compiled for The Heating and Ventilating Magazine, by the United States Weather Bureau.
Heavy lines indicate temperature in degrees F.
Light lines indicate wind in miles per hour.
Broken lines indicate relative humidity in percentage from readings taken at 8 A. M. and 8 P. M.
S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.
Arrows fly with prevailing direction of wind.

The War and the Heating Engineer

Coal Week.

"Coal week," from June 3 to 8, was widely observed in accordance with the suggestion of United States Fuel Administrator Garfield. During this week an intensive and specific drive was made on the early ordering of coal. The fuel administration has announced that the early ordering campaign will be vigorously pushed even though dealers are not able at the present time to get sufficient coal to fill all the orders. By accumulating a large volume of orders in the hands of the dealers it is expected that there will be demonstrated to every agency concerned in the distribution of coal, the universality and urgency of the demand.

Fuel Administration's Campaign for Fuel Conservation in Power Plants.

Thomas R. Brown of Pittsburgh, Pa., has been appointed administrative engineer for the United States Fuel Administration for the Pittsburgh district, and C. P. Billings has been named as special staff assistant. This is the first step of a plan inaugurated by the fuel administration for fuel conservation in power plants.

This plan is the result of conferences with the Federal Fuel Administrators and their committees for the group of States which together consume about 70% of all the coal used in the United States, exclusive of railroads. The plan has received the indorsement of the fuel administrators of all these States, as well as approval of the United States Bureau of Mines and a committee representing the Engineering Council of the four national engineering societies.

The slogan of the campaign is "Maximum production with minimum waste."

In laying the foundations for the organization it has been anticipated that this work should become a permanent service of the government.

Ten to twenty per cent—that is, from twenty-five to fifty million tons of coal per year—can be saved by the correct operation of steam power plants, using their present equipment, in the industries, in office buildings, hotels, apartment houses, etc.

It is considered most important that

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__________ $5. U. S. WAR-SAVINGS STAMPS at $__________ each
(State number wanted) (See prices below)
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W. S. S. COST DURING 1918

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May	4.16	Aug.	4.19	Nov.	4.22
June	4.17	Sept.	4.20	Dec.	4.23

W. S. S. WORTH $5.00 JANUARY 1, 1923

all existing fuel-conservation committees, committees of chambers of commerce and national defense, manufacturers' associations, and other bodies be continued in full force, and that the work of such organizations be consolidated with the national program, which comprises certain fundamentals, as follows:

1. Personal inspection of every power plant in the country.
2. Classification and rating of every power plant, based upon the thoroughness with which owner of said plant conforms to recommendation.
3. Responsibility of rating the plants will fall upon an engineer in each district, the rating to be based upon reports of inspectors, who will not express opinions, but will collect definite information. The State fuel administrator, in his judgment, may entirely or partially shut off the consumption of coal to any needlessly wasteful plant in his territory.
4. Inspectors are to be furnished from one or more of the following sources: (*a*) Inspectors of the steam-boiler insurance companies; (*b*) State factory inspectors; (*c*) engineering students from technical colleges; (*d*) volunteers.

The ratings will be based upon recorded answers to questions, each of which will be given a value depending upon its relative importance to the other questions. Depending upon the efficiency of methods in use in any plant, it may be rated in class 1, 2, 3 or 4.

SAVINGS FIGURED ON PRESENT EQUIPMENT

The ratings will be based upon existing equipment. The difficulty, delay, and expense involved in the installation at this time of improved power equipment is fully recognized, but experience has proved that 10 to 20% of fuel now used in power plants can be saved by improvements in operation alone.

In advance of the first inspection a questionnaire will be sent to every power plant in each district, with notice to the owner that within 60 or 90 days his plant will be inspected personally and the questionnaire will be checked up by the inspector upon his visit. This action will tend to prepare the minds of plant owners for what will follow. It will operate to induce proper care in furnishing information and will also tend to produce a desire to improve their plants, if necessary, so that they may be rated in a high class by the time the inspector calls.

It is recommended that a board of competent engineers be attached to the conservation committee in each State; also a corps of lecturers to arouse public interest and disseminate engineering information.

The Fuel Administration has prepared a 50-minute film of moving pictures showing good and bad operation in the steam-boiler plant, methods of testing boilers, fuels, etc. These pictures will be available for each State in connection with its educational propaganda.

The administration is also preparing a series of official bulletins on engineering phases of steam and fuel economics. Some of these are now ready for printing. They will include:

1. Boiler and Furnace Testing.
2. Flue Gas Analysis.
3. Saving Steam in Heating Systems.
4. Boiler-room Accounting Systems.
5. Saving Steam and Fuel in Industrial
6. Burning Fine Sizes of Anthracite.
7. Boiler Water Treatment.
8. Oil Burning.
9. Stoker Operation.

In addition to this service, a list of competent engineers has been prepared in Washington for each State and is available for use of each local administration. As the work develops, still further constructive assistance is contemplated for helping owners to bring their plants up to a high plane of economic operation.

Thrift Stamp Day to Be a Monthly Event.

Thrift Stamp day in the U. S. A. has come to stay, according to an announcement of the War Savings Stamp Committee. The results of the first Thrift Stamp day were so satisfactory that the National committee for Greater New York has decided to hereafter set aside every first day of each month as Thrift Stamp day.

June 14 Flag Day.

On June 14, which is Flag Day, steps are being taken by the National Americanization Committee to have a flag-raising in every industrial plant in the country. The special object sought this year is the promotion of patriotism in the plant, with the slogans of "every man on the job every day," "no needless days off," "no sabotage," "no strike on the job" and "no restricting of production by the workers." Employers are especially urged to help in the development of the loyal spirit among native and foreign-born employees by making them realize that America is the land of the square deal and then giving them a square deal in their plants. To this end employers are asked to take steps at once to give their employees who do not speak English an opportunity to learn the language.

A possible 650,000,000 bushels, the greatest winter wheat crop since the record-breaking yield of 1915, together with a probable increase of 15% in the acreage of spring wheat, is the forecast made in a report on the condition of winter wheat issued by the Chamber of Commerce of the United States through its committee on statistics and standards.

War Resolutions of United States Chamber of Commerce.

Among the resolutions adopted at the recent meeting of the United States Chamber of Commerce in Chicago was one in favor of universal military training, one urging careful scrutiny before the control of any industry is assumed by the government, one urging liberal treatment on the part of State and local authorities of public utilities, and one discouraging new business undertakings that do not contribute directly or indirectly toward the winning of the war.

Harry A. Wheeler is the newly-elected president of the United States Chamber of Commerce.

Heating Men in Military Service.

Allen Blomfeldt, of Blomfeldt & Rapp Co., Chicago, is attached to Company A, Twelfth Regiment, stationed at Camp Paul Jones, Great Lakes Training Station.

R. B. Hedlund, of the boiler department of the Illinois Malleable Iron Co., Chicago, has enlisted in the Navy.

First Lieutenant Earl T. Williams, of the 301st Field Artillery, stationed at Camp Devens, Ayer, Mass., was killed May 6, at Northampton, Mass., by the falling branch of a tree. Lieutenant Williams was vice-president of the J. H. Williams & Co., Brooklyn, N. Y., being formerly in charge of the manufacture of the company's line of chain wrenches at its Buffalo plant. He was graduated from Yale in 1910 and was formerly a member of Squadron A, New York.

Major R. A. Widdicombe, of Chicago, is now constructing quartermaster of Chemical Plant No. 4, Saltville, Va.

W. K. Abernethy, formerly manager of the Minneapolis office of the Central Station Steam Co., Detroit, Mich., has enlisted in the aviation corps and is at present stationed at Rich Field, Waco, Texas.

Archer A. Landon, vice-president of the American Radiator Co., in charge of the company's plant in Buffalo, has been appointed by Director John D. Ryan, director of the production division of the Aircraft Board.

D. Rait Richardson, president of the National Warm Air Heating and Ventilating Association, has resigned his office to enter the government service in the Construction Division of the Ordnance Department. Mr. Richardson will be located for the present in Washington. The annual convention of the National Warm Air Heating and Ventilating Association will be held in June so that Mr. Richardson's retirement comes almost at the end of his present term.

Early Coal-Buying Campaign in New Jersey.

Action to insure the early purchase and storage of coal and coke in New Jersey, for necessary domestic requirements, has been taken by Richard C. Jenkinson, Federal fuel administrator for the State, by the issuance of the following rules and regulations which are now in effect:

1. Until further notice no domestic consumer of coal or coke shall purchase, receive or otherwise take possession of more coal or coke than is required for his actual and necessary requirements prior to March 31, 1919. If such consumer already has a quantity of coal he shall receive only such additional amount as shall make up his actual and necessary requirements prior to that date.

2. No person, firm, association or corporation, whether acting alone or in con-

junction with others, shall, directly or indirectly provide any domestic consumer of coal or coke with more coal or coke before March 31, 1919, than is necessary with the amount already on hand, to meet the actual and necessary requiremnts of such consumer prior to that date.

3. On and after the date hereof, no person, firm, association or corporation shall sell or deliver coal to a domestic consumer who does not first furnish to the person selling or delivering such coal, a statement which the consumer declares in writing to be true, and which specifies (1) the amount of coal consumer has on hand. (2) the amount of coal he has on order and the name of the person from whom ordered; (3) the amount of coal used by him in the twelve months ending March 31, 1918, and (4) the amount of coal needed to meet the actual and necessary requirements prior to March 31, 1919.

4. Until further notice no retail dealer shall, unless authorized by the State Fuel Administrator, deliver or cause to be delivered to any domestic consumer more than one third of his normal annual requirements of anthracite until each domestic consumer who has placed his order with said dealer and is wililng to receive delivery of the same, has received one-third of his normal annual requirements for the year ending March 31, 1919; nor shall the dealer deliver more than two thirds of any domestic consumer's requirements until each domestic consumer, who has placed his order and is willing to receive delivery, has received two thirds of his requiremnts; provided, however, that requirements of six tons or less may be filled in full.

5. Car load or barge load lots shall not be delivered to a single domestic consumer, or to a group of consumers, except with the permission of the State Fuel Administrator.

6. Dealers may be required at any time to file with the local Fuel Administrator a statement containing the names and addresses of consumers to whom deliveries have been made and the quantity delivered to each.

ANY DEALER OR CUSTOMER WHO VIOLATES THE FOREGOING REGULATIONS WILL BE SUBJECT TO THE LEVER ACT, WHICH IMPOSES PENALTIES OF $5,000 FINE OR TWO YEARS' IMPRISONMENT, OR BOTH.

Accompanying the order is a blank form, copies of which are to be filled out by the individual consumers, giving an accurate statement of their present supply, last winter's requiremnts, etc.

CORRESPONDENCE

Steam Heating Problems.

EDITOR HEATING AND VENTILATING MAGAZINE:

Will you please answer the following questions:

Question No. 1: If 50 lbs. of steam are produced at 80 lbs. gage pressure and reduced to 5 lbs. gage pressure, how much steam do you have and is there any reduction or increase in the moisture?

Question No. 2: If previously a room was kept at around 80° F. and now it is reduced to 65°, what saving is there in coal in a year? Coal to have 12,000 B.T.U. Plant to room, 100 ft. Steam generated at 80 lbs. Reduced to 5 lbs. in heating system.

Question No. 3: If I have a 6-in. pipe and I have steam pressure on it of 80 lbs., how much steam is flowing through it?

Question No. 4: If I measure the returns from a building can I tell how much steam was put into the building or are there losses? If I know how much was put in and measure returns does that give me the efficiency of the system? How can that be increased?

Utica, N. Y. C. A. C., JR.

In reply to Question No. 1 we would say that there will be no difference in the quantity (weight) of steam because of a reduction in pressure. No steam is taken away during such a reduction and no steam is added. It is true that the *density* of the steam (pounds per cubic foot) is made less due to the expansion of the gas at the lower pressure and it is also true that the volume will be greater, but the quantity (by weight) remains the same.

There is likely to be less moisture in the steam at the reduced pressure for if the steam at the higher pressure is saturated (as it normally is) when reduced to the lower pressure a certain number of heat units are released which go to slightly superheat the steam at the lower pressure and to make up radiation losses in the valve and low-pressure piping. It is quite probable that the drip from a low-pressure main fed by a reducing valve would be a little less than the drip from a similar main fed directly from a low-pressure heating boiler; the difference, however, would not amount to a great deal.

In regard to Question No. 2, a room kept at 80° F (assuming zero outside as minimum temperature) would require roughly 80/70 of the radiation necessary to maintain 70°

and if reduced to 65° would require roughly 65/70 of the radiation necessary to keep it at 70°. We say "roughly" because the radiator at 80° room temperature will possess slightly less efficiency per square foot than when the room is at 65°.

Concerning the amount of coal saved we cannot even guess without knowing the amount of heating surface in the room, number of days heated, etc. The *percentage* of saving in the room can, however, be determined as follows:

Present temperature of room.........80° F.
Average winter temperature...........35° F.

Temperature difference maintained....45° F.
Proposed reduction of temperature to..65° F.
Average winter temperature...........35° F.
Proposed temperature difference.......30° F.

Then 45° : 30° : : present coal : X
or 30/45 × present coal = X
or 2/3 of present coal = proposed coal
Saving in coal = present coal — X or
present coal — 2/3 present
coal = 1/3, or
33 1/3% saving in room.

On the line run over from the plant the loss will not be reduced at all but (owing to no information being given as to the size of this line or its insulation) it is impossible to approximate this amount.

Question No. 3. The steam pressure in a pipe is no indication of the velocity of the steam flowing through it. If the end of the pipe were closed no steam at all would be flowing while if a steam engine or other apparatus were connected to the end of the line the flow might be almost anything as long as the pressure is maintained by a constant supply of steam being fed into the other end of the pipe.

Question No. 4. Many district heating companies measure their customers' steam consumption by metering their returns. Where automatic air valves are used there is doubtless some waste and loss which is not returned in the condensation; in a vacuum system there is practically no loss except through the leakage around the stem packing of the steam valves. In any case such losses are practically negligible.

If the quantity of steam supplied to a building is known so accurately that the returns can be measured and deducted therefrom, the difference would represent the *water* or *steam* loss in the building. This does not affect the *efficiency* of the heating as steam blown into a room in the form of vapor furnishes just as many heat units as when condensed in a radiator.

The only way the loss of steam on returns can be reduced is by re-packing valve stems to stop leakage and re-adjusting automatic air valves so as to shut tight when the steam strikes them. There is no particular object (from a heating standpoint) in the stoppage of such losses unless the cost of water is very high or the leakage becomes a nuisance.

The efficiency of a heating system is very close to 100%; that is, all the heat delivered by the steam into a heating system comes out in the form of heat either at the radiators or from the piping; the only loss likely to occur is in the heat carried back in the returns but even this is utilized if the returns are again fed into the boiler for re-evaporation.

Sizing Ducts and Flues.—Method No. 1 Questioned by Correspondent.

Editor Heating and Ventilating Magazine:

I noticed, in your April issue, the Data Sheet (No. 10-M) purporting to describe a method for designing duct systems, referred to as "Method No. 1" and which the author claims to have used; and I would hardly think any engineer who tries conscientiously to do the best work, would want to admit in print that he uses such guesswork methods.

The problem as stated is to deliver 1500 cu. ft. of air per minute from each of sixteen outlets. This is all the information we have, so we must make some assumptions. Now we cannot assume but one velocity condition, the others must be calculated from this assumption. For instance, we may assume a final velocity in each outlet of 400 ft. per minute in which case the velocity at the fan, and in all other portions of the system, must be calculated; or we may assume a velocity of 1000 ft. per minute at the fan in which case the final velocity must be calculated. The point I wish to bring out is that we cannot assume both. We cannot say we will use velocities ranging from 400 to 1000, as this writer has done, and expect satisfactory operation.

For this problem, if we assume a final velocity of 400 ft. and adjust our fan speed to get it, then the velocity at the fan will be about 815 ft. with a properly designed system. If we had assumed a velocity of 1000 ft. at the fan and had laid out the system correctly, the final velocity at the outlets *would not be* 400 ft. per minute, but about 485 ft. per minute. This means that if the trunk duct is cut down until a velocity of 1000 at the fan is obtained, the fan speed being adjusted to get this velocity, then the outlets, designed for 400 ft. velocity, will be too large, resulting in those near the fan taking more than their share of the air and causing the ones farthest from the fan to suffer.

It may be argued that dampers can be placed in the near outlets to choke them down. This, of course, is true, but if we are going to guess our duct sizes, and then choke them down with dampers, why not guess the sizes directly instead of going through the formality of guessing the velocity and then figuring the sizes from this? When we figure radiation, we don't put in twice as much surface as is needed and say, "Oh, let them turn half the radiators off, if it gets too hot."

Now there is nothing mysterious about figuring ducts, and there is positively no excuse for the existence of such methods as those proposed in the article referred to. The flow of air in ducts follows the same well-known laws that all fluids follow, and it is either laziness, or ignorance of these laws, which makes a man use slip-shod, careless methods in his duct calculations. The correct method is not any longer or more complicated, when properly understood than the method proposed. I worked out the duct sizes for the problem given, in less than 10 minutes by reference to a single diagram, which I figured out several years ago, whereon the sizes of the ducts may be read off directly, with practically no computations. In fact, I have often, in the case of very long ducts, read the sizes off to an assistant as fast as he could put the figures down. Can any method be any quicker than this?

It seems so evident to me that it is incorrect to base duct sizes entirely on velocity that I believe with a little consideration, all other engineers would also see it. I ceratinly hope your magazine will lend its influence toward discouraging such practice, as such make-shift methods of design are much more prevalent in heating and ventilating than in any other branch of engineering.

Cleveland, Ohio. L. K.

The duct system in question was illustrated in The Heating and Ventilating Magazine for April, 1918; on Standard Data Sheet No 10-M, and resulted in the following shedule of sizes:

Duct or Flue	Cu. Ft. per M.	Velocity Ft. M.	Area Sq. In.	Area Sq. Ft.
A	24,000	1000	3456	24.0
B	21,000	900	3360	23.3
C	18,000	850	3048	21.2
D	15,000	800	2700	18.7
E	9,000	600	2160	15.0
F	9,000	600	2160	15.0
G	6,000	500	1728	12.0
H	3,000	400	1080	7.5
J	6,000	750	1152	8.0
K-M-O-P-Q	1,500 (ea.)	400	540	3.75
L	4,500	600	1080	7.5
N	3,000	500	864	6.0

According to our correspondent the sizes as shown on his sketch submitted with his letter should be as follows:

Duct or Flue	Cu. Ft. per M.	Velocity Ft. M.	Area Sq. In.	Area Sq. Ft.
A	24,000	815	4248	29.5
B	21,000	800	3787	26.3
C	18,000	765	3384	23.5
D	15,000	714	3024	21.0
E	9,000	630	2059	14.3
F	9,000	630	2059	14.3
G	6,000	571	1512	10.5
H	3,000	465	929	6.45
J	6,000	571	1512	10.5
K-M-O-P-Q	1,500 (ea.)	400	540	3.75
L	4,500	529	1224	8.5
N	3,000	465	929	6.45

The main difference between the two appears to be that our correspondent increases his velocities at a slightly lower rate than that called for in the data sheet although what determines this rate is not given, unless it is the diagram to which he refers. If this diagram possesses the property of allowing a duct system to be sized "as fast as the figures can be put down" it is one that will be recognized as having great value for the designing engineer.

Our correspondent's letter was referred to the author of the data sheet in question and his reply follows:

The correspondent is wrong in his contention that duct systems sized on a proportional velocity basis running in graduated steps from the highest velocity at the fan outlet down to the lowest velocity at the farthest end of the system will not give results, for many systems so sized are giving the air required at the points desired which is all any system can do.

If the correspondent admits that air *can* be delivered from the system illustrated in the locations and quantities noted, then his own scheme falls to the ground as he proposes to deliver the same quantity of air to the same locations *but by using flues and ducts of larger areas* the increases varying up to almost 25% additional area at the fan. Why?

If the correspondent takes the position that the duct system as illustrated—or others designed in the same manner—will *not* deliver the air in the locations and quantities desired it is useless to attempt to discuss the matter for there are too many systems in operation today all giving (as near as any ventilation system can give) the results desired.

The correspondent asserts that "we can not assume but one velocity condition and the others must be calculated from this assumption." Possibly so—to get a theoretically correct design in the system—but what is the use of being theoretically correct if it takes more galvanized iron? Good engineering consists of getting the *best* results with the *least* expenditure more than it does of being theoretically correct.

There *is* a weakness of the "assumed velocity" method which the critic, however, has not mentioned. This is the fact that the friction loss is likely to vary for every change in duct size and only an experienced designer can tell the approximate static pressure necessary to deliver the air in the quantity desired, and it is this pressure, together with the volume, which determines the size and speed of the fan. There are usually, however, so many variables on a duct system that great refinements in this direction are not desirable. A little experience along this line will usually enable one to come very close to actual results, especially when the velocities are always kept between the same limits.

It has never been claimed that a system designed in this manner is theoretically perfect, but only that it is practical and gives practical results. Of course, volume dampers are used with it and if correspondent has had any experience in ventilating work he uses volume dampers, too. It is indeed entirely impractical under the conditions of modern construction to design systems without such control, as the heating system is installed in the building and not the building built around the heating system.

The sizing of a flue and the sizing of a steam radiator is hardly comparable and it would have been much better if the sizing of a flue or duct (rather than the "outlet") were compared to sizing the steam pipe for a given radiator. In each case the device serves as an avenue through which a given quantity of a medium flows and every one will agree that there is considerable difference of opinion as to what the proper size of a steam pipe should be.

Would it not be desirable to have the correspondent submit full data of his method of figuring duct and flue sizes for presentation in the pages of the magazine, leaving it to the readers to use the systems which they find most practical and least laborious? And are "make shift methods of design more prevalent in heating and ventilating than in any other branch of engineering?"

◆

Figuring Heat Losses.

EDITOR HEATING AND VENTILATING MAGAZINE:

We would appreciate some information on the following: On Standard Data Sheet No. 1 why is the heat loss greater through a brick wall plastered on the inside, than through a plain brick wall?

Is this the way you would figure a 6-in. tile and 2-in. concrete roof with paper, tar and gravel, top layer 25.2, one foot air space and lath and plastered ceiling, 43.4,

$$\frac{1}{252} + \frac{1}{434} = \frac{686}{108768} \text{ or } 15.8 \text{ B.T.U. at } 70^\circ\text{F.}$$

Also in figuring radiation required, do you figure the actual size of the opening, or just the size of the glass?

Pittsburgh, Pa. J. A. L. & S. Co.

In regard to the question on plastered walls we refer our readers to the answers to two other correspondents putting the same question in THE HEATING AND VENTILATING MAGAZINE for March, 1917.

For figuring the combination of roof and hung ceiling the method used by the correspondent is practically correct but his figures make no allowance for the additional insulation secured by means of the air space. A simpler method is to assume the temperature of the air in the air space and then calculate the losses from the lath and plaster alone based on the temperature difference between the 70° in the room and the assumed temperature of air space. This is usually taken as 35° or 40°.

If greater accuracy is necessary the theoretical temperature of the air in the air space can be calculated from the following:

For every square foot of ceiling it is known that there will be a loss of 0.62 B.T.U. per degree, which loss will radiate into the air above the ceiling. This will warm the air so that the heat will warm the roof and be lost therefrom. It is known that the roof loss is 0.36 B.T.U. per degree and since the roof loss must be constantly made up by the heat from the ceiling below, it follows that a state of equilibrium will be reached when the roof loss equals the ceiling loss.

To find the theoretical temperature of the air in the air space it follows that this temperature must be such that the *difference between the room temperature and the air* *space temperature, times the co-efficient for the ceiling, must equal the difference between the outside temperature and the air space temperature, times the co-efficient for the roof, or*

$$TD_1 \times CE_1 = TD_2 \times CE_2$$

when TD_1 is the temperature difference between air space and room

TD_2 is the temperature difference between air space and outside

CE_1 the co-efficient for the ceiling

CE_2 the co-efficient for the roof.

Then $TD_1 \times 0.62 = TD_2 \times 0.36$.

The sum of the two temperature differences must equal 70 if the room is 70° and the outside zero.

Then $TD_1 + TD_2 = 70$

and $0.62\ TD_1 = 0.36 TD_2$

or

$TD_1 + TD_2 = 70$

$0.62\ TD_1 - 0.36\ TD_2 = 0$

which may be solved for TD_1 as follows:

$$\begin{aligned} 0.36\ TD_1 + 0.36\ TD_2 &= 25.2 \\ 0.62\ TD_1 - 0.36\ TD_2 &= 0.0 \\ \hline 0.98\ TD_1 \qquad &= 25.2 \\ TD_1 \qquad &= 25.6 \text{ say } 26^\circ \end{aligned}$$

$$\begin{aligned} \text{Then if } TD_1 + TD_2 &= 70 \\ TD_2 &= 70{-}26 \\ TD_2 &= 44^\circ \end{aligned}$$

Then the air space will be 26° below the room and 44° above the outside temperature or 44° F.

Proof—

$70^\circ - 44^\circ = 26^\circ\ TD_1$

$26 \times 0.62 = 16.1$, say 16 B. T. U. loss through ceiling $44^\circ - 0 = 44^\circ\ TD_2$

$44 \times 0.36 = 15.8$, say 16 B. T. U. loss through roof.

These being equal the conditions are in a state of equilibrium and the correspondent's result checks with the loss obtained above.

In reply to correspondent's last question, the entire area of a window or door opening should be figured—*not* the glass or sash only.

Current Heating and Ventilating Literature.

Under this heading is published each month an index to the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the article mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

Heating Demand

Average and Maximum Heating Demand. M. W. Ehrlich. 1800 w. Power—March 5, 1918. Method of computing the coal consumption. 20c.

Steam and Electric

Public Steam and Electric Systems. J. A. M'Hollan. 2000 w. Elec Wld—March 9, 1918. Analysis of the building heating situation in large cities. 20c.

Recent Tests on Pressed Steel Radiators.

Tests were recently completed at the University of Michigan by Professor J. E. Emswiler and H. E. Keeler on four pressed steel radiators in heights ranging from 14 to 38 in. and on one cast-iron radiator 38 in. in height.

Although the value of K (B.T.U. per hour per square foot per degree difference) was remarkably low for the pressed steel radiators, the report states that "the low value of K has no special significance except in comparison with other radiators. These pressed radiators appear to be able to keep the room temperature up to the same point as the cast-iron and do it by pushing out less heat per square foot of surface. If this is a fact, as appears from our tests, then it really matters little what K is, except that it raises a question that is hard to answer, and until we can answer it, our results will be open to possible suspicion."

The cast-iron radiator tested is the standard Rococo radiator, made by the American Radiator Company. The pressed steel radiators are the product of The American Pressweld Radiator Corporation and are made of a special copper-bearing sheet steel, shaped and then welded to form the sections.

The radiators were all tested in the same room (No. 244 in the Engineering Building, at the University of Michigan) and only one radiator operated at a time. The room was carefully sealed so that there was no circulation of air other than that induced by the radiator being tested.

All the tests were made at night. The room temperature was recorded at twelve different points and at varying heights from the floor to the ceiling. An anemometer was suspended above the center of the radiator, at its middle, to give a clue to the relative movement of the air.

The heat input to the radiator was determined by the "electrical method." A small boiler well insulated, received heat from an electric current through a resistance heater. The boiler was connected directly to the radiator, this constituting a complete one-pipe heating plant within the room. The electric current passed through a watt-hour meter arranged to give a definite indication for each 1⅔ watts, or 6 B.T.U. The pressure of steam, and, therefore, the temperature in the radiator, was automatically maintained at any point desired. The number of watts, or heat units dissipated by the boiler itself was easily determined by calibration, and was, of course, deducted from the gross energy input, to secure the net performance of the radiator.

It was necessary to set the radiator upon a platform 6-in. above the floor because of the boiler. In order that the radiator should not be higher than it normally should be with respect to the windows, strips of heavy paper were pinned across the sash of the windows immediately adjacent, thus cutting off 6-in. of glass, corresponding to the elevation of the radiator.

THE METHOD OF TESTING

As soon as pressure was built up within the radiator, it was thoroughly purged of air. Usually, while this was being done, the watt-hour meter was calibrated by comparison with portable instruments. Observations were then begun, and repeated at intervals of 15 minutes. As each set of observations was completed, the temperatures at the three levels in the room were averaged and the averages plotted on time as abscissae. The watts absorbed during the 15-minute interval were computed and plotted. In this manner, there was presented to the eye a picture of input to radiator and its effect in the room temperature. After some time, input and effect settled down to a constancy, and the test was usually continued for an hour after such equilibrium had begun to be attained.

Following the completion of a test, the valve between boiler and radiator was closed. The pressure in the boiler was automatically maintained, and a calibration of the boiler could be obtained at this time. The hot radiator could be immediately disconnected in the meantime, and a new one substituted. The change could be effected, and pressure established in the new radiator within 20 minutes of turning steam off the radiator previously tested. It took some time to purge the new radiator of air, but as soon as this was done, the new test could be begun and continued in the manner described above.

THE RESULTS

The results appear in Tables I, II and III. Table I represents the general conditions prevailing during the tests, the principal dimensions of the radiators, the averages of the most important observations, and performance of the radiators as represented by the heat dissipated by them. Table II presents the averages of many accessory observations which do not enter into the calculations, but nevertheless may have much significance. Table III is a summary of the

TABLE I—RADIATOR TESTS—GENERAL RESULTS

General						
1. No. of Test	7	8	9	10	12	13
2. Date—1918	3-16	3-17	3-17	3-17	3-30	3-30
3. Time	10:30 P 11:30P	1:00 A 2:00A	3:30A 4:30A	5:20A 6:35A	9:00P 10:00P	11:30P 12:30A
4. Duration—minutes	60	60	60	75	60	60
5. Weather	Fair	Fair	Fair	Fair	Fair	Fair
6. Wind	None	None	None	None	None	None
Radiator Data						
7. Name		Rococo				
8. Type	Pr. St'l.	C. I.	Pr. St'l.	Pr. St.	Pr. St.	Pr. St.
9. No. Sections	21	12	16	20	20	10
10. No. columns	3	2	1	4	4	3
11. Length—inches	42	29 1/2	32	40	40	18
12. Width—inches	8	7 1/2	4 3/4	12	12	8
13. Height—inches	18	38	38	14	14	38
14. Rated Surface—sq. ft.	47 1/2	48	48	45	45	50
Average of observations						
15. Barometric Pr.—inches	29.46	29.46	29.22	29.22	29.18	29.15
16. Pressure in radiator—inches above at m.	4.80	4.80	4.80	4.80	4.72	4.72
17. Pressure in radiator—inches abs.	34.26	34.26	34.02	34.02	33.90	33.87
18. Pressure in radiator—pds. per. sq. in.	16.82	16.82	16.70	16.70	16.64	16.63
19. Temp. of steam in rad.	218.9	218.9	218.5	218.5	218.3	218.3
20. Room Temp.	73.9	74.1	73.4	73.3	80.2	79.9
21. Room humidity—per cent	33	31	29	30	33	38
22. Outside temp.	38.0	39.0	39.0	38.5	46.6	46.7
Computed Quantities						
23. Temp. diff. (19-20)	145.0	144.8	145.1	145.2	138.1	138.4
24. Gross watts input per hr.	2788	336.3	3003	2807	2551	2623
25. Watts per hr. dissipated from electric boiler	240	240	240	239	219	219
26. Net watts per hr. dissipated from radiator	2548	3123	2763	2568	2332	2404
27. B. T. U. per hr. from radiator	8698	10665	9432	8770	7964	8210
28. B. T. U. per. hr. per sq. ft.	184.1	222.2	196.5	194.9	177.0	164.2
29. B. T. U. per hr. per sq. ft. per degree, difference equals K	1.270	1.534	1.354	1.342	1.282	1.186
30. K for tests 12 & 13 increased by 4.7 per cent to correct for high Rm. Temp.					1.342	1.242

TABLE II—RADIATOR TESTS—SPECIAL TEMPERATURES

1. No. of test.	7	8	9	10	12	13
2. Type of Radiator	Pr. St'l.	C. I.	Pr. St'l.	Pr. Stl.	Pr. Stl.	Pr. Stl.
3. No. Sections	21	12	16	20	20	10
4. Length	42	29 1/2	32	40	40	18
5. Height.	18	38	38	14	14	38
6. Rated Surface, sq. ft.	47 1/4	48	48	45	45	50
7. Temp. air at floor, deg. F.	71.4	71.3	70.7	70.4	77.7	77.8
8. Temp. air 5 ft. from floor	72.0	72.4	71.7	71.6	79.6	79.2
9. Temp. air at ceiling	76.7	78.2	76.2	75.2	81.3	82.7
10. Nominal Temp. of room	73.9	74.1	73.4	73.3	80.2	79.9
11. Temp. 4 3/4 in. above top radiator	86.5	113.9	91.5	82.3	115.0	123.2
12. Temp. 4 1/4 in. in front of radiator and 8 in. below level of top of radiator	89.0	90.8	89.8	84.4	90.6	95.2
13. Dry bulb temperature, deg. F.	73.9	73.5	73.9	73.0	81.0	81.3
14. Wet bulb temperature, deg. F.	57.4	56.1	55.2	54.9	62.5	64.00
15. Humidity per cent	33	31	29	30	33	38
16. Temp. on far side of north wall	65.5	63.0	61.7	61.0	68.5	66.9
17. Temp. on far side of east wall	66.0	64.3	63.7	63.2	70.2	71.0
18. Temp. on far side of south wall	82.6	83.0	83.0	83.0	80.6	82.2
19. Velocity—ft. per min. thru anemom.	—	49	0	43	53	5.3

TABLE III—SUMMARY OF PERFORMANCE OF RADIATORS

Cast iron radiator	38 in.	2-col,	12 sec.	48 sq. ft.	K equals 1.534
Pressed steel radiator	38 in.	1-col,	16 sec.	48 sq. ft.	K equals 1.354
Pressed steel radiator	38 in.	3-col.	10 sec.	50 sq. ft.	K equals 1.242
Pressed steel radiator	18 in.	3-col,	21 sec.	47 1/4 sq. ft.	K equals 1.270
Pressed steel radiator	14 in.	4-col,	20 sec.	45 sq. ft.	K equals 1.342

performances of the several radiators arranged for convenient reference.

The report emphasizes the fact that "some very unusual results appear." In test No. 7, for instance "a pressed steel radiator 18 in. was on the stand. It dissipated heat at the rate of 8698 B.T.U. per hour and maintained the room at a temperature of 73.9° F., with the outside air at 38° F. The cast-iron radiator was then put on, and test No. 8 begun an hour and a half after test No. 7 was finished. It was found that this radiator required 10665 B.T.U. per hour to maintain the temperature of the room at 74.1° (0.2° higher than before) with the outside at 39°. Stated more concisely, it appears that the cast-iron radiator got away with nearly 23% more heat than the pressed steel radiator, without putting any more into the room. The question naturally arises as to where this 23% goes to, and I must confess that I am unable to answer it.

"As having a probable bearing on the question, it is to be noted that the temperature of the air above the pressed metal radiator is only 86.5° (test 7) vs. 113.9° above the cast-iron (test 8). But the pressed metal radiator of test 10 is only 18-in. high, while the cast-iron is 38-in. In test 13, where a pressed metal radiator of 38-in. height is used, the temperature above is 123.2°, although it must be remembered that the room temperature was much higher."

(In previous radiator tests, it has been brought out that it is difficult, if not impossible, to separate the radiant heat losses in a radiator from the convection heat losses. It is also not known how much radiant heat goes directly out through the walls and windows without being effective. Professor John R. Allen has stated that so far as he can determine, about half the heat in a radiator goes off by radiation and half by convection. Applying this ratio to the present experiments, the difference of 23% would mean that in radiant heat losses, pressed steel radiators give off 50% less by radiation than cast-iron. When a radiator is actually used it is ordinarily painted and if both types of radiators are painted with the same material, the radiant losses would depend upon the paint rather than on the material composing the radiator.)

◆

Pressure and Temperature Control in an Office Building Supplied with Steam From a Central Station.

The control of the amount of steam entering a building for heating purposes has for many years received rather indifferent consideration. There may be two reasons assigned for this situation: First, where steam was sold on a meter basis, the control of steam consumption was not of vital interest to the company supplying this steam; second, where steam was sold on a flat-rate basis, the exact knowledge of the amount of steam delivered was lacking.

Investigations made by some of the members of the National District Heating Association, coupled with the demand for conservation of fuel, have led to a more definite inquiry into the control heat.

The results of a test made during the past winter at Peoria, Ill., in the office building of the Central Illinois Light Co., we believe are of sufficient interest to central stations to attract attention to the subject of control, especially at this time.

The valve employed on this test is the central station pressure and temperature control valve, developed by J. C. Hornung, of Chicago, and in this case, his magnetic pilot valve was used for controlling the temperature.

Fig. 1 shows the manner in which the clock and chart attachment was put on the valve, so as to record the valve position throughout the 24-hour cycle.

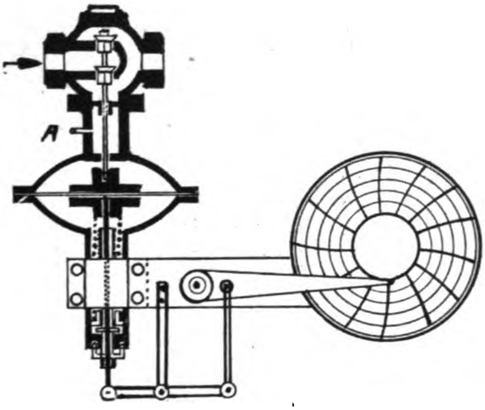


FIG. 1—ARRANGEMENT OF CLOCK AND CHART ATTACHMENT.

It will be seen that in this valve, the pressure, as well as the temperature, is controlled. The adjustment for pressure is made with a coil spring enclosed in the diaphgram case and the adjustment screw is provided with keeper for seal or padlock. The valve under normal operation is thus shown to have two positions, one being a partly open position, to maintain the minimum pressure required, and the other a closed position when no heat is required.

A magnetic pilot valve was connected between the steam supply and the main valve case, at point marked A in Fig. 1.

When the pilot valve is closed, the valve acts purely as a pressure-control valve, but when the pilot is open, the supply pressure acts on the top of the diaphragm, thus closing the valve. It is also to be noted that there are no stuffing boxes, the clearances along steam forming passages for control.

The thermostat, which is the automatic switch for the pilot valve, is arranged so that lower temperatures may be carried during the night hours.

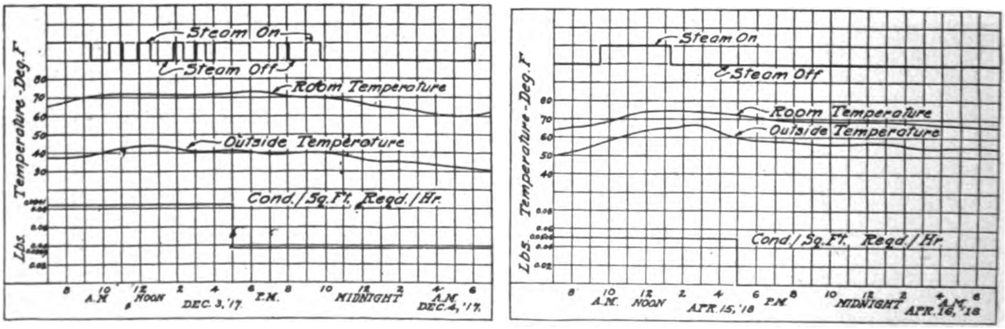
Two typical daily reports and graphs are shown to indicate the performance of the valve, and to present the interesting results in the form of daily steam consumption. The steam consumption per square feet of equivalent direct radiation per hour, which is now the standard unit, is especially interesting.

The test is instructive at this time when high fuel economies are so urgently requested.

H. R. Wetherell, engineer for Hodenpyl, Hardy & Co., and past president of the National District Heating Association, together with J. A. Strawn, superintendent of the steam department at Peoria, Ill., outlined the test. The daily observations and readings were made under the supervision of Mr. Strawn.

REPORT ON THERMOSTATIC DATA, DECEMBER 3-4, 1917.

1. Outside temperature. Max. 44°F., Min. 30°, Mean. 37°.
2. Thermostat lever set as follows—
3. Average inside temperature near thermostat, 65.1°.
4. Maximum inside temperature, 70.2°.
5. Minimum indoor temperature, 60.0°.
6. Service valve closed at— } open entire period
7. Service valve opened at— }
8. Time in hours that service valve was opened, 24.
9. Time in hours that thermostat controlled steam supply, 24.
10. Number of times that thermostat shut off steam supply during above time, 8.
11. Hours that thermostat had steam shut off in this time, 15.
12. Total number of hours that steam was off building, 15; on building, 9.
13. Steam consumption (day), 4400 lbs. in 9.92 hours, 0.084 lbs. per square foot of equivalent direct required radiation per hour.



TYPICAL DAILY GRAPHS, OFFICE BUILDING TEST.

14. Steam consumption (night) 2700 lbs. in 14.00 hours 0.037 lbs. per square foot E. D. R. per hour.
15. Steam consumption (total in 23.92 hrs.) 7100 lbs. or 0.057 lbs. per square foot E. D. R. per hour.

REPORT ON THERMOSTATIC DATA, APRIL 15-16, 1918.

1. Outside temperature. Max. 76°F., Min. 50°. Mean. 63°.
2. Thermostat lever set as follows—
3. Average inside temperature near thermostat, 71°.
4. Maximum inside temperature, 74°.
5. Minimum indoor temperature, 68°.
6. Service valve closed at— } open entire period
7. Service valve opened at— } open entire period
8. Time in hours that service valve was opened, 24.
9. Time in hours that thermostat controlled steam supply, 24.
10. Number of times that thermostat shut off steam supply during above time, 1.
11. Hours that thermostat had steam shut off in this time, 22¼.
12. Total number of hours that steam was off building, 22¼; on building, 1¾.
13. Steam consumption (day), 1200 lbs. in 9.83 hours, 0.023 lbs. per square foot of equivalent direct required radiation per hour,
14. Steam consumption (night), 100 lbs. in 14.42 hours, 0.001 lbs. per square foot E. D. R. per hour,
15. Steam consumption (total in 24.25 hrs.) 1300 lbs. or 0.012 lbs. per square foot E. D. R. per hour.

◆

What Instruments Are Useful and Desirable in the Boiler Room as Aids in Saving Coal?

Efforts to get away from the old idea of having meters and recorders in the boiler room to "show up" the fireman, were urged by E. G. Bailey in his contribution to the coal symposium at the meeting of the American Society of Mechanical Engineers, in Worcester, June 6. Mr. Bailey advocated the use of meters that will actually assist the fireman to carry the load required of his boilers and, at the same time, obtain the maximum efficiency that is possible at that load. He used the word "meter," he said, in its broad sense to include all instruments down to a coal scale when they are used to obtain knowledge regarding boiler-plant conditions.

Mr. Bailey described the principal controllable losses in boiler operation as (1) combustible in ashes and refuse; (2) excess air; (3) unburned gas; and (4) high temperature of flue gases. He then divided meters into four types: (1) condition; (2) total; (3) rate; and (4) relation. From an operating standpoint he said the meters which show rate, including boiler feed, steam flow, air flow, stoker speed, etc., are the most important, as it is better for a fireman to know the rate of steam output from each boiler continuously than to wait until the end of his shift and learn the average rate from a water meter that integrates total only. Of course, time is an important factor in boiler operation and the fireman should know final results promptly and continuously.

Another important relation is that between rate of steam generation and rate at which fuel is burned. With coal, about the closest approach is the relation between the steam flow meter and tachometer on the stoker drive, although he added that this was a very crude method of determining the rate at which the B.T.U. are supplied to the furnace.

There is another relation, however, that is analagous to the steam-flow ratio that is readily obtained and of even greater value. It is the relation between the rate of steam flow from the boiler and the rate of air flow which supports combustion. Mr. Bailey stated that the amount of air required to develop a given number of B. T. U. is practically independent of the character or quality of coal being used.

Mr. Bailey recommended the use of recording, rather than indicating, meters, and stated that power plant engineers were rapidly adopting this type, especially where indicating meters had previously been used.

◆

Newport Boiler Company Wins Suit Brought Against It by the Spencer Heater Company.

The United States Circuit Court of Appeals, Judges Baker, Mack and Evans sitting, on May 3, 1918, rendered a unanimous decison in Case Number 2551—Spencer Heater Company vs. Newport Boiler Company, affirming a decree of the District Court for the Northern District of Illinois.

This suit was brought more than two years ago by the Spencer Heater Company against the Newport Boiler Company and it was alleged that the magazine-feed boilers sold by the Newport Boiler Company were infringements of certain patents owned by the Spencer Heater Company. The District Court held that patent No. 1,045,668, owned by the Spencer Heater Company, for a so-called double-type sectional, magazine-feed boiler and patent No. 1,063,088, also owned by the same company, for a so-called single-type sectional, magazine-feed boiler, were not infringed by the sectional boilers sold by the Newport Boiler Company. The Spencer Heater Company appealed from this decision with the result above noted.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Plans for Buffalo Meeting.

Sessions on drying, district heating and coal conservation are included in the programme for the mid-summer meeting of The American Society of Heating and Ventilating Engineers which will be held in Buffalo, N. Y., June 26-28.

C. A. Booth, sales manager of the Buffalo Forge Company, is chairman of the local entertainment committee and according to the arrangements made, the afternoon sessions on Thursday, June 27, will be held at the Buffalo Canoe Club on the Niagara River followed by a dinner and dance at the clubhouse.

Society's New Year Book.

A total of 769 members is listed in the new year book of the society which has just been published for 1918. In addition there are 35 applications for membership in the hands of Secretary C. W. Obert. All the officers are listed, both of the society and of the various chapters, together with the personnel of the society's different committees. A complete list is added of the past officers of the society.

New York Chapter's Annual Dinner.

War work and practical considerations for the heating engineer shared the honors at the annual dinner of the New York Chapter which was held at the Building Trades Club, New York, May 20. The war speakers included W. O. Wilson, who told of Y. M. C. A. work in France, and Wayne M. Musgrave, whose subject was the Red Cross.

The main address of the evening was given by Milton W. Franklin on "Spontaneous Combustion." Mr. Franklin's talk showed a thorough study and understanding of the subject and he held the close attention of his audience throughout his address. Walter S. Timmis expressed his appreciation of Mr. Franklin's paper and paid a tribute to the work of the chapter during the past year, closing by calling for a rising vote of thanks to President Chew. Other speakers were Past President J. I. Lyle and G. W. Martin, president of the National District Heating Association.

Annual Dinner and Dance of Illinois Chapter.

President Frederick R. Still of the heating engineers' society was the guest of honor at the annual dinner and dance of the Illinois Chapter, which was held May 13 at the Chicago Athletic Club. Following the dinner, which was accompanied by entertainment features, President E. Vernon Hill of the Illinois Chapter, addressed the members and then presented President Still as the speaker of the evening. Mr. Still made an interesting address on the Irish question, based on his personal observations during his trip to Ireland two years ago. He expressed his belief that conscription would be a blessing in disguise for Ireland.

At the close of his address he was given a rising vote of thanks.

Kansas City Chapter Appoints Legislative Committee.

Following the discussion of "Heating and Ventilation of School Buildings," which was the principal topic at the chapter's April meeting, the chapter appointed a committee on legislation, consisting of Stanley Field, chairman; and J. H. Kitchen, W. E. Gillham, F. J. McMorran and N. W. Downes, to cooperate with a similar committee of the Kansas City Chapter of the American Institute of Architects.

At the annual meeting of the Kansas State Association of Public Health officers, held in Topeka May 23-24, the speakers included John H. Kitchen, secretary of the Kansas City Chapter, who presented a paper on "Heating and Ventilating School Buildings."

◆

New Edition of Gifford's "Central Station Heating."

An idea of the rapid progress that has been made in the development of central station as well as changed conditions under which the industry is operating is presented in the new edition of "Central Station Heating," by Byron T. Gifford. In addition to a careful revision of the text in the first edition, Mr. Gifford has added important new chapters covering the subjects of "Accounting," with details of a cost and accounting system in straight and combination plants; "Economics and Design of High-Pressure Distribution Systems," "Modern Insulation and Construction," and "Replacement and Renewal Reserve and How To Figure It."

Of the new matter appearing in the second edition, that on "Accounting" will undoubtedly take rank as the most complete discussion of the subject that has appeared in print. Under this heading the author deals with the classification of accounts for heating utilities and the division of costs and expenses between the heating and electric departments in a combination property. The classification is not new but, on the contrary, is one that has been found to work out successfully in use. The added information brought out in this chapter alone is probably sufficient to justify the publication of the new edition.

An important feature of central station operation these days is the necessity of keeping the property intact by creating an annual reserve for replacement and renewal purposes. This subject is now given the attention it deserves.

The addition of a chapter on "The Design of High-Pressure Steam Distribution System," supplements very nicely the matter in the first edition on the design of low-pressure systems. In connection with this matter the author presents a new high pressure pipe chart that will greatly facilitate the solution of these problems.

"Central Station Heating," is recognized as a standard manual on the subject of district heating and has served, in many cases, as a guide in the deliberations of public utility commissions in the establishment of fair rates for the sale of steam and hot water. The author's well-known reputation for conservatism and sound engineering, which was reflected in his treatment of what was at the time the first complete manual on the subject of district heating, will be enhanced by his further treatment of the subject.

The second edition of "Central Station Heating" is now on the press. It will be issued about June 15. The new edition will be bound in cloth and will sell for $3.00 postpaid. The publishers are the Heating and Ventilating Magazine Company.

◆

Proposed Rules and Contract Form for Central Station Hot Water Heating in Indiana.

The central station hot water heating utilities have, in the past, been billing their consumers upon square feet of radiation required by formula and not upon square feet of radiation set, and on account of the abuse of the application of this principle, the hot water heating problem has been forced to an acute situation by what is described by the State Public Service Commission as high and unreasonable billing and a lack of good service. The Commission is desirous of basing the billing for hot water heating service on something tangible which both the utility and the consumer may see, measure and agree to, and after the correct number of square feet of radiation has been established, to standardize the number of B.T.U. per square foot of radiation which the utility is supposed to provide for corresponding outside temperatures.

As a result of this situation a set of proposed rules and a proposed contract form have been prepared by the Public Service Commission of Indiana in collaboration with the United States Bureau of Standards. At a conference held in Indianapolis on June 4, all of the central station hot water heating interests in the State were asked to be present, as well as sev- service. It was hoped that at that conference the tentative rules and contract form could be thoroughly discussed and the way paved for their adoption in their present or in an amended form.

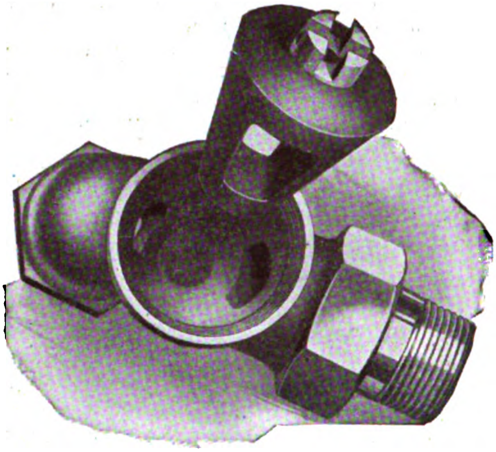
As soon as the rules and contract form are promulgated in their final form a digest of their salient features will be presented in these columns.

◆

A Plug-Type Radiator Valve.

It is a good mechanical principle that the best device is the one that fulfils its purpose in the most direct manner, with the least motion and the least number of working (which means wearing) parts. The plug type of valve which has been placed on the market by the Gorton & Lidgerwood Co., New York, is described by the manufacturers as fulfilling these requirements in being simple, direct in operation, and opening and

GORTON PLUG-TYPE RADIATOR VALVE.



CONSTRUCTION OF GORTON PLUG-TYPE RADIATOR VALVE.

closing with the minimum of motion. The accompanying illustrations show a type of plug valve which has been developed for radiator work. The principal feature is the plug, or disc, which is made of a composition, and not of metal. This composition is a mineral substance and, it is stated, contains neither sulphur nor rubber, so that it is not affected by steam or by hot or cold water. In the manufacture of the composition the substance is cast in a master steel mould and compressed under heavy hydrostatic pressure. It is then machine ground to a taper surface and carefully gauged as to accuracy in a master steel cup gauge.

The valve seat is the entire inner surface of the valve, this arrangement providing a large bearing surface for the disc. The interior is bored, reamed, finished to the same taper as the disc and tested for accuracy with a master steel plug gauge. Emphasis is laid on the point that the seat and disc, being ground to the same taper surfaces, permit as close contact as it is possible to produce. The disc has the same ratio of heat expansion as the valve body and, being a mineral composition disc working in a metal seat, both ground to the same taper, will, it is claimed, not cut or wedge. It is also pointed out that the composition in the plug will not rust or corrode.

A quarter turn of the lever handle turns the plug from full open to closed position. Another advantage, it is stated, is in the packing features. There is no horizontal motion of the valve stem, a radial turning of the stem actuating the plug. Therefore it is possible to use a packing lock stem. There is a ground shoulder on the valve stem which seats itself on the ground seat on the under side of the stem opening in the valve bonnet. This is the same principle that is used successfully in safety valve construction. The valve stem also has a groove which is fitted with soft, but firm, packing rings, these rings being forced and locked into the groove by means of a gland forced down by the packing box nut, making a packing lock. These two features, it is added, are only possible in the plug-type of valve. Finally, the steam or water has a clear, unobstructed passageway through the valve.

◆

Deaths.

GEORGE O'HANLON, of New York, well known in the local heating trade and a member of the heating engineers' society, was fatally injured in an automobile accident May 19. He died shortly afterwards at the New York Hospital. Mr. O'Hanlon was born in Ireland in 1867. He was identified with the early activities in the heating industry in this country, being associated with Edward E. Gold & Company and with Blake & Williams. Later he entered business for himself as a consulting heating and ventilating engineer. He is survived by a widow and one child.

FREDERICK REMSEN HUTTON, honorary secretary of The American Society of Mechanical Engineers and a former president of that society, died at his home in New York, May 14. He was 64 years old. Professor Hutton was emeritus professor of mechanical engineering at Columbia University.

CHARLES JENKINS, for many years connected with Jenkins Bros., New York, died May 1 at his home in Winthrop, Mass. He was 73 years old. Mr. Jenkins retired from the firm in 1896 and has since devoted his time to his real estate interests. His brother, Alfred B. Jenkins, president of Jenkins Bros., died a little over a year ago.

F. E. LALLY, manager of the New York branch of Crane Company, died in New York, April 3.

◆

Central Station Steam Co., Detroit, Mich., announces that D. T. Wallace, formerly manager of the sales department of the New York Steam Co., has become associated with the Central Station Steam Company as manager of its Minneapolis branch.

RULES FOR FLANGED FITTINGS.

American 1915 Standard, Standard Weight.

1. Standard reducing elbows carry same dimensions center-to-face as regular elbows of largest straight size.

2. Standard tees, crosses and laterals, reducing on run only, carry same dimensions face-to-face as largest straight size.

3. Where long-turn fittings are specified, it has reference only to elbows which are made in two center-to-face dimensions and to be known as "elbows" and "long-turn elbows," the latter being used only when so specified.

4. All standard weight fittings must be guaranteed for 125 lbs. working pressure, and each fitting must have some mark cast on it indicating the maker and guaranteed working steam pressure.

5. Standard weight fittings and flanges to be plain faced, and bolt holes to be 1/8 in. larger in diameter than bolts; bolt holes to straddle center lines.

6. Size of all fittings scheduled indicates inside diameter of ports.

7. Square head bolts with hexagonal nuts are generally recommended for use.

8. Double-branch elbows, side-outlet elbows and side-outlet tees, whether straight or reducing sizes, carry same dimensions center-to-face and face-to-face as regular tees and elbows.

9. Bull-head tees or tees increasing on outlet, will have same center-to-face and face-to-face dimensions as a straight fitting of the size of the outlet.

10. Tees, crosses and laterals 16-in. and smaller, reducing on the outlet, use the same dimensions as straight sizes of the larger port.

Sizes 18-in. and larger, reducing on the outlet, are made in two lengths, depending on the size of the outlet, as given in the table of dimensions.

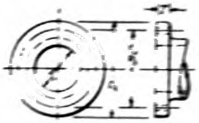
11. For fittings reducing on the run only, a long-body pattern will be used. Y's are special and made to suit connections. Double-branch elbows are not made reducing on the run.

12. Steel flanges, fittings and valves are recommended for superheated steam.

13. If flanged fittings for lower working pressure than 125 lbs. are made, they shall conform in all dimensions, except thickness of shell, to this standard and shall have the guaranteed working pressure cast on each fitting. Flanges for these fittings must be standard dimensions.

1915 Standard Weight Flanges and Bolts.

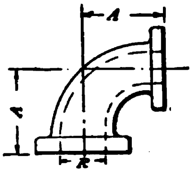
125 Lbs. Working Pressure



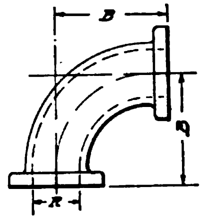
PIPE	FLANGE		BOLTS			Bolt Holes
Size in. diam. P	Diam. in. D	Thickness in. T	No.	Size In. diam.	Bolt circle In. B. C.	Size In. diam.
1	4	7/16	4	7/16	3	9/16
1 1/4	4 1/2	1/2	4	7/16	3 3/8	9/16
1 1/2	5	9/16	4	1/2	3 7/8	5/8
2	6	5/8	4	5/8	4 3/4	3/4
2 1/2	7	11/16	4	5/8	5 1/2	3/4
3	7 1/2	3/4	4	5/8	6	3/4
3 1/2	8 1/2	13/16	4	5/8	7	3/4
4	9	15/16	8	5/8	7 1/2	3/4
4 1/2	9 1/4	15/16	8	3/4	7 3/4	7/8
5	10	15/16	8	3/4	8 1/2	7/8
6	11	1	8	3/4	9 1/2	7/8
7	12 1/2	1 1/16	8	3/4	10 3/4	7/8
8	13 1/2	1 1/8	8	3/4	11 3/4	7/8
9	15	1 1/8	12	3/4	13 1/4	7/8
10	16	1 3/16	12	7/8	14 1/4	1
12	19	1 1/4	12	7/8	17	1
14	21	1 3/8	12	1	18 3/4	1 1/8
15	22 1/4	1 3/8	16	1	20	1 1/8
16	23 1/2	1 7/16	16	1	21 1/4	1 1/8
18	25	1 9/16	16	1 1/8	22 3/4	1 1/4
20	27 1/2	1 11/16	20	1 1/8	25	1 1/4
22	29 1/2	1 13/16	20	1 1/4	27 1/4	1 3/8
24	32	1 7/8	20	1 1/4	29 1/2	1 3/8
26	34 1/4	2	24	1 1/4	31 3/4	1 3/8
28	36 1/2	2 1/16	28	1 1/4	34	1 3/8
30	38 3/4	2 1/8	28	1 3/8	36	1 1/2
32	41 3/4	2 1/4	28	1 1/2	38 1/2	1 5/8
34	43 3/4	2 5/16	32	1 1/2	40 1/2	1 5/8
36	46	2 3/8	32	1 1/2	42 3/4	1 5/8
38	48 3/4	2 3/8	32	1 5/8	45 1/4	1 3/4
40	50 3/4	2 1/2	36	1 5/8	47 1/4	1 3/4

1915 Standard Weight Elbows and Reducers.

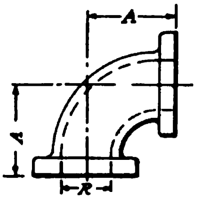
125 Lbs. Working Pressure



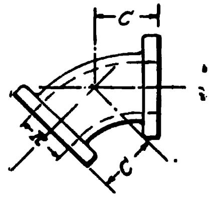
Elbow.



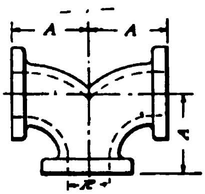
Long-Turn Elbow.



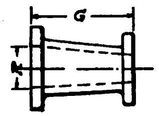
Reducing Elbow.



45° Elbow.



Double-Branch Elbow.



Reducer.

SIZE In.Diam.	DIMENSIONS, In.				FLANGE	
R	A	B	C	G	Diam. In.	Thickness In.
1	3 1/2	5	1 3/4	—	4	7/16
1 1/4	3 3/4	5 1/2	2	—	4 1/2	1/2
1 1/2	4	6	2 1/4	—	5	9/16
2	4 1/2	6 1/2	2 1/2	—	6	5/8
2 1/2	5	7	3	—	7	11/16
3	5 1/2	7 3/4	3	6	7 1/2	3/4
3 1/2	6	8 1/2	3 1/2	6 1/2	8 1/2	13/16
4	6 1/2	9	4	7	9	15/16
4 1/2	7	9 1/2	4	7 1/2	9 1/4	15/16
5	7 1/2	10 1/4	4 1/2	8	10	15/16
6	8	11 1/2	5	9	11	1
7	8 1/2	12 3/4	5 1/2	10	12 1/2	1 1/16
8	9	14	5 1/2	11	13 1/2	1 1/8
9	10	15 1/4	6	11 1/2	15	1 1/8
10	11	16 1/2	6 1/2	12	16	1 3/16
12	12	19	7 1/2	14	19	1 1/4
14	14	21 1/2	7 1/2	16	21	1 3/8
15	14 1/2	22 3/4	8	17	22 1/4	1 3/8
16	15	24	8	18	23 1/2	1 7/16
18	16 1/2	26 1/2	8 1/2	19	25	1 9/16
20	18	29	9 1/2	20	27 1/2	1 11/16
22	20	31 1/2	10	22	29 1/2	1 13/16
24	22	34	11	24	32	1 7/8
26	23	36 1/2	13	26	34 1/4	2
28	24	39	14	28	36 1/2	2 1/16
30	25	41 1/2	15	30	38 3/4	2 1/8
32	26	44	16	32	41 3/4	2 1/4
34	27	46 1/2	17	34	43 3/4	2 5/16
36	28	49	18	36	46	2 3/8
38	29	51 1/2	19	38	48 3/4	2 3/8
40	30	54	20	40	50 3/4	2 1/2

FITTINGS—Std. Wt. Elbows and Reducers, Flanged. No. 107-B.

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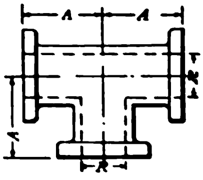
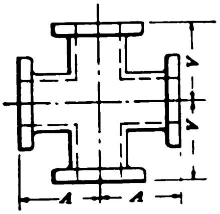
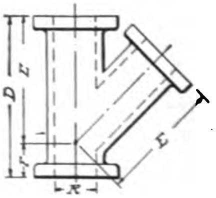


STRAIGHT TEE.



STRAIGHT CROSS.



STRAIGHT LATERAL.

SIZE In. Diam. R	DIMENSIONS In. A	D	E	FLANGES Diam. In.	Thickness In.
1	3 1 2	7 1 2	5 3 4	4	7 16
1 1 4	3 3 4	8	6 1 4	4 1 2	1 2
1 1 2	4	9	7	5	9 16
2	4 1 2	10 1 2	8	6	5 8
2 1 2	5	12	9 1 2	7	11 16
3	5 1 2	13	10	7 1 2	3 4
3 1 2	6	14 1 2	11 1 2	8	13 16
4	6 1 2	15	12	9	15 16
4 1 2	7	15 1 2	12 1 2	9 1 4	15 16
5	7 1 2	17	13 1 2	10	15 16
6	8	18	14 1 2	11	1
7	8 1 2	20 1 2	16 1 2	12 1 2	11 16
8	9	22	17 1 2	13 1 2	1 1 8
9	10	24	19 1 2	15	1 1 8
10	11	25 1 2	20 1 2	16	1 3 16
12	12	30	24 1 2	19	1 1 4
14	14	33	27	21	1 3 8
15	14 1 2	34 1 2	28 1 2	22 1 4	1 3 8
16	15	36 1 2	30	23 1 2	1 7 16
18	16 1 2	39	32	25	1 9 16
20	18	43	35	27 1 2	1 11 16
22	20	46	37 1 2	29 1 2	1 13 16
24	22	49 1 2	40 1 2	32	1 7 8
26	23	53	44	34 1 4	2
28	24	56	46	36 1 2	2 1 16
30	25	59	49	38 3 4	2 1 8
32	26	—	—	41 3 4	2 1 4
34	27	—	—	43 3 4	2 5 16
36	28	—	—	46	2 3 8
38	29	—	—	48 3 4	2 3 8
40	30	—	—	50 3 4	2 1 2

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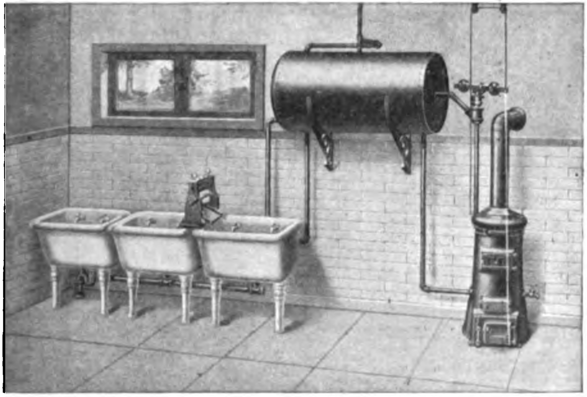

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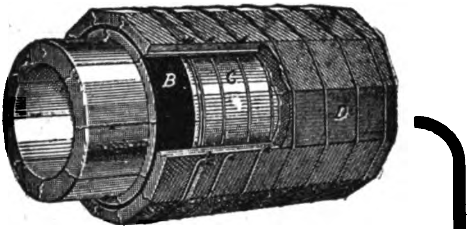

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THE HEATING AND VENTILATING MAGAZINE

Cooperstown, N. Y. JULY, 1918 1123 Broadway. New York

Reasons for Failures of Heating Systems

BY J. D. HOFFMAN

(From a Paper Presented at the Summer Meeting of the American Society of Heating and Ventilating Engineers, in Buffalo, N. Y., June 26-28, 1918.

The time has come for a campaign of education for more satisfactory heating and ventilation in the homes of our country. Buildings of larger proportions have been carefully worked out, because of their importance as public utilities, have been treated with such respect by both architect and engineer as to insure fairly satisfactory service. The home of the private citizen of moderate means, on the contrary, still suffers greviously and the need for such agitation is apparent. The society should do this and some means should be found through which to educate the public to demand and see that they get more satisfactory heat in their homes.

POOR BUILDING CONSTRUCTION

The recent coal situation has served the purpose of calling to the attention of heating and ventilating engineers that in the future the economic problems of the home must necessarily become more vital factors. Heretofore they have pacifically endeavored to fit their heating and ventilating systems into ill-conceived and poorly constructed houses and have trusted to their ability as engineers to overcome the handicap imposed upon the systems by architects or constructors who knew little and cared less about the requirements of home comfort. The heating and ventilating engineers this past winter have shown their willingness to do anything in their power to tide over the acute stages of panic and suffering due to the fuel shortage. They have unceasingly conseled "fewer fires" and "more economic firing," because under the conditions this was all that could be done. Then, nothing counted as much as direct coal saving but now that the stress of severe winter has passed, we may ask ourselves: What and how may the heating and ventilating engineers do to assist in laying the foundation of a more effective economy in the years just ahead?

I have especially in mind some of those conditions (principally residential) that not only work against economic heating, but absolutely prevent it in a large number of cases. Some of these conditions are due to the mistakes of the architect with knowledge afore-thought or otherwise, some of them to those of the heating man (or hardware man) who installs the system, and some to those of the householder who practising false economy is not willing to pay the price of good work.

CAMPAIGN NEEDED FOR BETTER BUILT HOUSES

We need to urge a campaign for better built houses—houses that are made to *live in* and not merely to rent or to *sell.* It is a sad commentary on our American domiciles, but it is a fact that the average residence is a satisfactory habitation for only nine months in the year. It has been stated that in 1912, 75% of the residences built in the United States cost each $5,000 or less. This ratio, if correct, has probably not changed much in the interim. From what I know of the methods of construction of the average residences of this class, I am safe in venturing that 75% of this number are not satisfactorily heated. Further, I am wiling to venture that 75% of the number not giving satisfaction are failing, not so much from the lack of gray matter on the part of the heating man, as from unsatisfactory house design and construction.

In most of the ordinary balloon-framed houses the sheathing is very inferior in grade and loosely butted at the edges, when there should be solid boards and lap joints. Some of the houses have no building paper or its equivalent, some have one course of the building paper and a few have two, but very few courses are laid with care to serve as an insulation. Two courses of paper in face contact are, it should be stated, inferior to one course with the sheathing and one course woven in and out over the studding; or, to one course with the sheathing and one course on the inside of the studding, with strippings under the laths to bring the plaster free from the paper surface. Again, suppose the wall is well protected against inleakage but the upper and lower ends of the spaces between the studs are open; in this case there is free convection of air upwards between the inner and outer layers of the wall and the heat that should be kept within the room is dissipated to this air current and lost to the attic, and the conditions are worse than the open wall in that the heat is lost and there is no corresponding physical benefit from inleakage.

TYPICAL CASES OF POOR BUNGALOW CONSTRUCTION

One of the worst types of construction, and one I have frequently met with, is the bungalow type second floor outer wall which offsets within the plane of the first floor outer wall. Irrespective of the type and quality of main wall construction (balloon-frame, brick or stone), the second floor wall is studded down from a ceiling level near the roof line, lathed and plastered on the inside of the studs and on the ceiling; and the outside of the studs and joists left open to the cold spaces under the roof. In two, otherwise well-designed and properly-heated stone bungalows called to my attention recently, where the heating systems were pronounced failures, the heat lost through the second floor walls and ceilings to the cold spaces underneath the roof was so great that a cold draft of air down the open stair was sufficient to make the first floor uncomfortably cold. A careful inspection of the heating systems showed them sufficient in capacity to supply similar buildings with ordinarily well constructed walls, and excessive in capacity for the heavy stone outside walls those houses had.

Everything seemed to be satisfactory but as a last resort I asked to see the attic construction. Here we found that the exterior walls and ceiling of the second floor had only one ordinary lath and plaster thickness separating the rooms from the attic spaces. The outside temperatures at the time were near zero and the temperature in the attic spaces showed that the heat was going through these plaster partitions like water through a sieve. My advice in each case was to surface the outside of the studs and joists with heavy building paper or tight boards, or better, with both. I have mentioned these two cases because they show how a splendid construction may be set at naught by inexcusable carelessness in some hidden detail of construction. These houses that on the face of things were overheated, were as a matter of fact only partially heated and through no fault of the heating man excepting that he should have insisted upon knowing what kind of construction would be used in these various walls. Most cases of poor house construction that come to the attention of the heating and ventilating engineer differ, however, from the ones mentioned in that the failures are due to *general house debility* and it is more difficult to say which bad feature has the greatest effect to produce failure of the heating system.

POOR PRACTICE TO CARRY PIPES THROUGH ATTIC

It frequently happens that in order to conceal the piping the heating engineer frequently crosses the wall and carries his pipes through the attic spaces. The practice improves the appearance of the room somewhat (and some householders insist upon it), but it is opposed to economy. In one striking example of how not to do it, a new vapor system was installed in a stone bungalow last summer with all the second floor returns and some of the mains traversing these attic spaces. The result was a freeze-up in every radiator on the windward side, alternating of course as the wind shifted so as to give every room some of the same experiences, and during one week of the extreme weather last winter every second floor radiator was out of commission. No insulation was put on the pipes and I doubt if they could have been successfully insulated against the zero temperatures which were indicated by the thermometer near the pipes. Vapor system returns are especially susceptible to freezing conditions.

OVERHANGING ROOMS SHOULD HAVE WELL-INSULATED FLOORS

Another feature of house design that is frequently fatal to the plans of the heating engineer is the overhanging room with only one thickness of ⅞ inch flooring on the room and light ceiling over the porch. This always gives a cold floor that is not only uncomfortable to the occupants, but eliminates heating possibilities on cold days. These remarks do not apply of course to sleeping porches with no heat. If an overhanging room is desired, be sure to provide for a well-insulated floor.

LOOSE CONSTRUCTION AROUND WINDOWS

One feature of house construction that reflects against the builder rather than the architect is the loose construction around the windows. The owner wishes free moving sash and the workmen give him everything he could desire in this regard. But how about the person who is expected to inhabit the room on a zero day when the wind is blowing a 20 mile velocity? I have caught snow in my hand at a distance of 2 ft. from a tightly-locked window, in a house supposed to have better than ordinary construction. What can the society do to better such conditions? Window strips, metal weather strips, and storm windows may be urged. Storm windows, top hung, give satisfactory insulation during the cold days and at the same time provide ventilating possibilities on moderate days. An average nine-room house can be supplied with good storm windows, west, north and east for an expenditure of from $75 to $100 and the coal saving will pay for the first cost in two years time. Such storm windows are no hindrance to open-window ventilation when desired.

OUTSIDE CHIMNEYS NOT GOOD DRAFT PRODUCERS

Next, let us look at the chimney. Several points in common practice among architects tend toward inefficiency. The outside chimney, in spite of its possibilities toward exterior ornamentation, is not a good draft producer because of the chilling effect of the outside air. Where a chimney is required in an outside wall it should be not less than two bricks thick (8 in.) on each side of the flue at the thinnest part, increasing to at least 12 in. on the lowest part. This is improved if the chimney wall is double with an air space between the walls. Such an air space may be closed in with an occasional layer of header bricks from the outside wall nearly touching the thinner wall. These header bricks cut off air circulation and in addition steady the inner wall. They must not bind the walls together since the lineal expansion of the two shafts are not equal. The chimney is improved occasionally by an ornamental wall of cobble stones laid up on the outside of the chimney proper. All chimneys should have an inner lining of hard burned tiles well cemented at the joints and embedded with the inner brick surfaces.

Let me add a word of caution in regard to the inside chimney: *Under no consideration should the house construction be rigidly fixed to the chimney.* This is too frequently done. The expansion and contraction of the chimney causes movement of the floors, thus cracking the walls and ruining the fits of the doors, casings, etc.

SPACE RESTRICTIONS IN WARM-AIR FURNACE HEATING

So far I have been pleading for better *exterior construction* since this is the most vital. The points touched upon do not by any manner of means exhaust that part of the subject, but now notice what the heating man encounters in the *interior construction*, with indirect heating, or say *furnace heating*. (Steam and hot water direct heating may, of course, be fitted to almost any building no matter what the interior construction may be.) Of the unsatisfactory furnace systems, I wager that 75% fail because the architect and constructor have restricted the heating man to such a degree that the heat lines of his system are too small to carry the heat necessary to supply the loss through the outside walls and windows. If this statement is even only approximately true, then it would seem that our society has neglected the furnace heating business. Any one of the necessities of the home that is so vital to so many of our people should be more carefully guarded.

To note some of these limitations, taking them in the order of first importance, the *wall stack* is, in my opinion, the chief offender. In houses of this classification ($5,000 or less), the interior walls are built of 4 in. studding, set 16 in. on centers. This gives, allowing for shrinkage of the studs, approximately 3¾ by 14¼ in. maximum cross section of opening through which the vertical air ducts (stacks) are run. Since stacks fit loosely in this space and are supposed to be insulated from the wood work of the wall by one or two layers of asbestos paper, single walled stacks will be about 3⅝ by 14 in. and double walled stacks (two stacks fastened symmetrically with each other with a thin air space between), 3¼ by 13⅝ in. All such stacks are of tin or light galvanized iron, and as such cause very little friction in the movement of air through them, but they fail because they are *too thin* or because they have *too many right-angled turns.* The maximum wall stack has say 45 sq. in. net cross sectional area. This will supply a 10x12 ft. centrally located room having small exposure, but is not sufficient for large rooms or for heavily exposed rooms.

Can't we conceive of some new styles of first floor designs that will permit square, or nearly square, air shafts instead of the elongated rectangle whose effective cross area approaches zero?

Another point, chargeable principally to the owner, is the low basement ceiling that reduces the pitch of the leaders to a minimum. If the average householder realized the importance of extra pitch to the pipes in the basement; he would let loose of enough additional capital to guarantee a ceiling height of 8 ft. instead of 6 ft. as is so often found.

Another point, tabooed by the average furnace man as unnecessary, is the return metal duct. No furnace plant should be installed that has any part of its air lines formed by merely tinning along the edges of the studs and joists. This is against the laws of the convection of air and is an offense against the sanitation of the building. The almost universal custom among furnace men is to take air from off the floor of the room, together with dust and all, and carry it back to the basement through a duct that has one side of very rough plaster, two ends of rough studs and one side of tin. In many cases this is continued to the furnace between rough joists on two sides, a fairly loose floor above and tin beneath. After a while the collection of dusts and micro-organisms that deposit on these rough surfaces would fill a cemetery if turned loose en masse on the neighborhood. Why not add a few dollars to the building and make a smooth duct system with hand holes at intervals to permit cleaning once each year by swabs or fans as the case may require. Not only will the house be more sanitary but the heating system will come nearer giving satisfaction because the laws of friction have been considered intelligently. Teach the householders what to expect and most of them follow your advice.

The conditions governing the pitch of the pipes, aggravating as they may be, are to a greater or less degree within the control of the heating man. Friction, on the other hand, is a worse enemy to overcome because the conditions controlling it are bound up with the house wall construction and this is usually fixed by the architect before the problem is put up to the heating man. I have no desire to shift the burden of responsibility. The mediocre heating man, especially the furnace man who knows enough to buy a furnace at the cheapest price but does not know enough to install it correctly, is a detriment to the heating profession, but in many cases he is more sinned against, than a sinner. He is the victim of a type of construction that even the best at times stumble over. What we need in this country is a type of building construction that looks toward comfort, utility and permanency.

AVERAGE HOME BUILDER SHOULD BE INFORMED OF STRUCTURAL REQUIREMENTS.

Is it not possible to develop a campaign of education in such a way that the average man who may be contemplating building himself a little home may become more informed on these vital points that are so necessary in coordinating the heating and ventilating features with the building construction, and in that way develop an independent thinker who will not be wholly at the mercy of the unscrupulous promoter or the uninformed individual who frequently poses as an architect or engineer? Such a movement to be effective must be supported by some organization of men whose interest in the best things under discussion can not be questioned. The press of the country is always ready to assist in anything that stands for the public good so long as it is convinced that the movement is bona fide and under competent supervision. May the time soon come when we will build our houses to serve as homes and not as private cantonments.

CHICAGO COMMISSION ON VENTILATION

Determining the Heat Given Off by Engines and Power Piping

By Dr. E. V. HILL,
Chief, Division of Ventilation of the Chicago Health Department
and
W. J. MAUER,
Engineer, Chicago Commission on Ventilation.

Some time ago the Engineering Department of the City of Chicago requested the Ventilation Division of the Health Department to conduct tests with the view of determining the amount of heat supplied to the engine room of pumping stations by the engines and power piping in the building. In stations formerly erected the amount of radiation that should be omitted, due to the heat supplied by the engines and accessories, and absorbed by the cold water mains, etc., was largely a matter of guess work, as no accurate data on this subject were available.

The problem at hand was the new Mayfair pumping station, then under construction. This station was to have seven Reidler-type triple-expansion engines, three with a capacity of 17,500,000 gal. each, at 140-ft. head, and four with a capacity of 25,000,000 gal. each, at a 25-ft. head, operating at 185 lbs. steam pressure. To secure the necessary information as to the heat that would be supplied by these engines we decided to make a test in the Lake View pumping station, which has a similar equipment, except that there are only four engines of the Mayfair type, with a capacity of 25,000,000 gal. each in the Lake View station. Besides these engines the accessory equipment, such as condensers, air-pumps, steam lines,

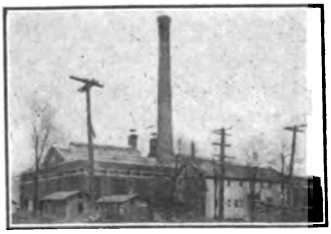


Fig. 1—Looking North.

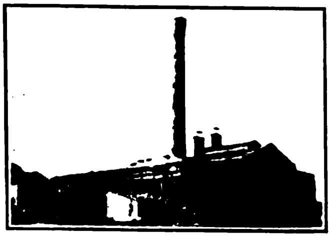


Fig. 2—Looking Northwest.

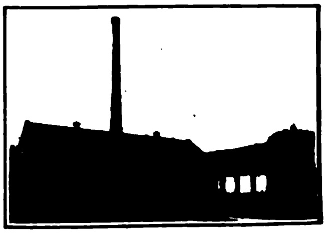


Fig. 3—Side View of Engine Room, Looking West, in which Test was Made.

LAKE VIEW PUMPING STATION.

etc., must, of course, be taken into consideration.

It is evident that in order to determine the net heat supplied by this equipment we must determine the air change in the building under average winter conditions. We must also know the heat loss from the building, due to temperature differences on inside and outside of engine-room walls. The following method, therefore, was adopted:

PLAN OF TEST.

All radiators were shut off and the windows and doors closed as in cold weather. The room was kept under observation with these conditions until the interior temperature ceased to rise. It is evident that this is the point where heat loss balances the heat supply. By calculating now the heat losses from the building, from a careful analysis of construction, the amount of heat required to maintain this temperature is obtainable. This amount will be the heat loss, due to wall transmission, plus the heat required to warm the total amount of the air passing through the room, from the outside temperature to the room temperature. If the air change can be determined, it will be a simple matter to determine the amount of heat required to warm this air. This amount subtracted from the net total will give the heat supplied by the engines and accessories. It is necessary, therefore, to first determine the air change per hour. To solve this part of the problem the following method was used:

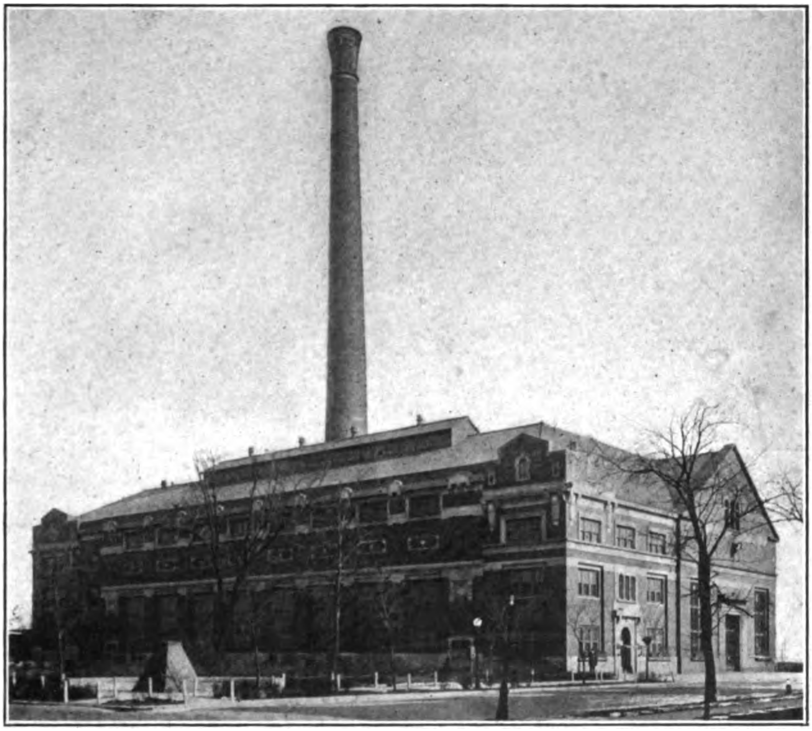


FIG. 4.—LAKEVIEW PUMPING STATION, LOOKING NORTHEAST.

Eight empty oil barrels were placed on the first floor of the engine-room, three on the east side, three on the west and one each on the north and south sides. (See plan of engine-room Fig. 5.) In each barrel 12½ lbs. of dilute sulphuric acid were placed and at a given signal 18 lbs. of a saturated solution of sodium bi-carbonate were added to each barrel. In this way carbon dioxide gas was liberated at a rapid rate and rather uniformly throughout the room. After a sufficient interval had elapsed to allow a complete chemical change to take place in the barrels that no further CO_2 gas be given off and to allow a thorough diffusion of the gas throughout the room, air samples were taken at various predetermined points and later analyzed for carbon dioxide.

In making the test the room was divided into four cross-sections and observations were made at six points, two on each side at three different elevations of each cross-section. These stations are shown in Fig. 5. The air samples previously referred to, together with the temperature and humidity observations, were taken at each of three points hourly. From the temperature readings the "Temperature Curve" (Fig. 9) was plotted, which was used to determine the temperature differences at various elevations. Readings on both sides of the boiler-room wall of the engine-room showed practically no temperature difference, hence no heat transmission would occur in this wall.

AIR CHANGE.

It is evident that the reduction in the amount of CO_2 in the engine-room shown by the hourly readings was due to dilution with the outside air. Knowing the amount of CO_2 in the room and the amount in the outside air it is a simple matter to calculate the air change from these data. The various CO_2 readings are tabulated herewith and from these the average CO_2 is found for each hour.

To show the method of arriving at the conclusions let us take 8.5 parts of CO_2 per 10,000, which is the amount recorded as the average amount in the

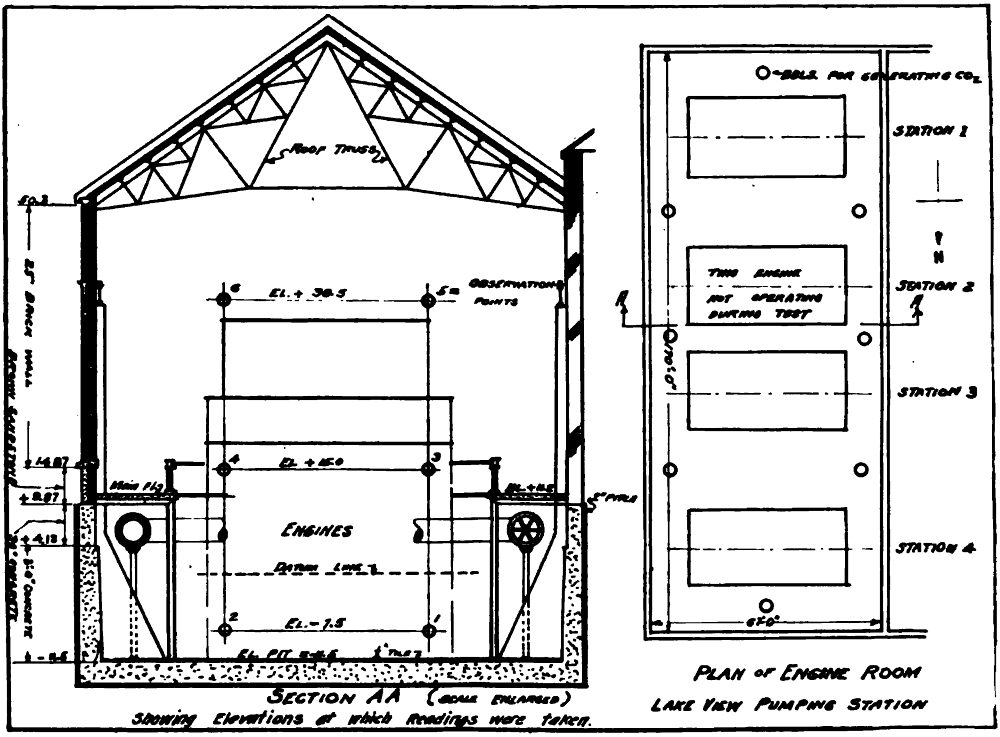
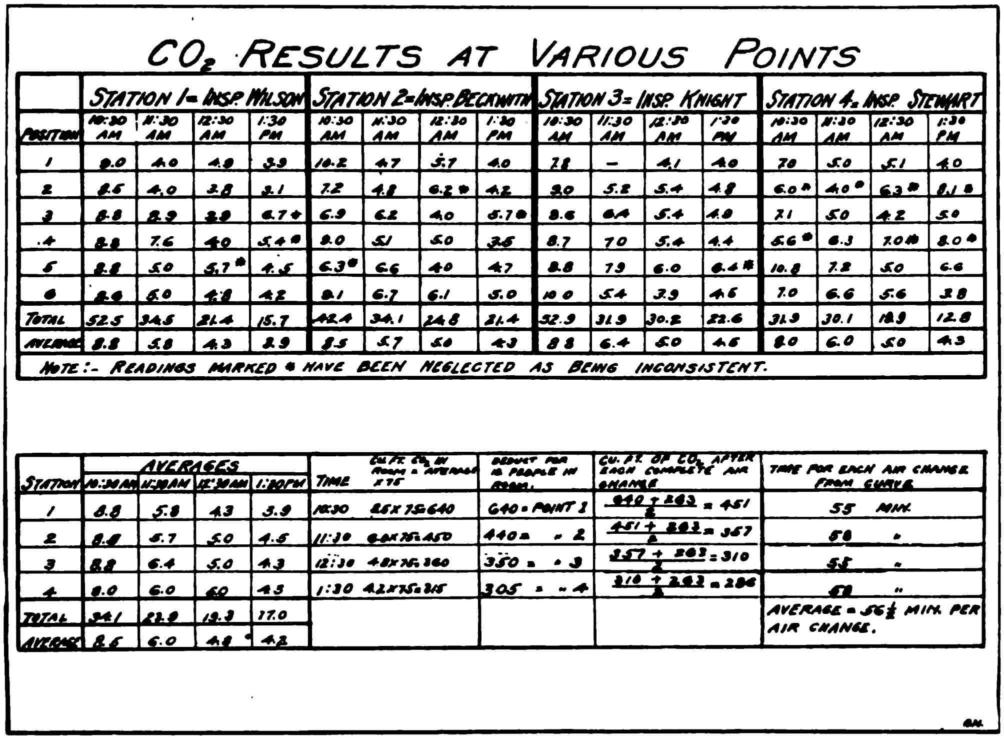


FIG. 5.—PLAN AND ELEVATION OF LAKEVIEW PUMPING STATION.



CO₂ RESULTS AT VARIOUS POINTS

	STATION 1 = INSP. WILSON				STATION 2 = INSP. BECKWITH				STATION 3 = INSP. KNIGHT				STATION 4 = INSP. STEWART			
POSITION	10:30 AM	11:30 AM	12:30 AM	1:30 PM	10:30 AM	11:30 AM	12:30 AM	1:30 PM	10:30 AM	11:30 AM	12:30 AM	1:30 PM	10:30 AM	11:30 AM	12:30 AM	1:30 PM
1	9.0	4.0	4.9	3.9	10.2	4.7	5.7	4.0	7.8	—	4.1	4.0	7.0	5.0	5.1	4.0
2	8.5	4.0	3.8	3.1	7.2	4.8	6.2 *	4.2	9.0	5.2	5.4	4.8	6.0 *	4.0 *	6.3 *	8.1 *
3	8.8	3.9	3.9	6.7 *	6.9	6.2	4.0	5.7 *	8.6	6.4	5.4	4.8	7.1	5.0	4.2	5.0
4	8.8	7.6	4.0	5.4 *	9.0	5.1	5.0	3.5	8.7	7.0	5.4	4.4	5.6 *	6.3	7.0 *	8.0 *
5	8.8	5.0	5.7 *	4.5	6.3 *	6.6	4.0	4.7	8.8	7.9	6.0	6.4 *	10.8	7.2	5.0	6.6
6	8.6	6.0	4.8	4.2	9.1	6.7	6.1	5.0	10.0	5.4	3.9	4.6	7.0	6.6	5.6	3.8
TOTAL	52.5	34.5	21.4	15.7	42.4	34.1	24.8	21.4	52.9	31.9	30.2	22.6	31.9	30.1	19.9	12.8
AVERAGE	8.8	5.8	4.3	3.9	8.5	5.7	5.0	4.3	8.8	6.4	5.0	4.6	8.0	6.0	5.0	4.3

NOTE:- READINGS MARKED * HAVE BEEN NEGLECTED AS BEING INCONSISTENT.

	AVERAGES				TIME	CU. FT. CO₂ IN ROOM = AVERAGE × 75	DEDUCT FOR 12 PEOPLE IN ROOM.	CU. FT. OF CO₂ AFTER EACH COMPLETE AIR CHANGE	TIME FOR EACH AIR CHANGE FROM CURVE
STATION	10:30 AM	11:30 AM	12:30 AM	1:30 PM					
1	8.8	5.8	4.3	3.9	10:30	8.5 × 75 = 640	640 = POINT 1	$\frac{640+263}{2} = 451$	55 MIN.
2	8.5	5.7	5.0	4.5	11:30	6.0 × 75 = 450	440 = " 2	$\frac{451+263}{2} = 357$	58 "
3	8.8	6.4	5.0	4.3	12:30	4.8 × 75 = 360	350 = " 3	$\frac{357+263}{2} = 310$	55 "
4	8.0	6.0	5.0	4.3	1:30	4.2 × 75 = 315	305 = " 4	$\frac{310+263}{2} = 286$	58 "
TOTAL	34.1	23.9	19.3	17.0					AVERAGE = 56½ MIN. PER AIR CHANGE.
AVERAGE	8.5	6.0	4.8	4.2					

FIG. 6.—RESULTS OF CO_2 READINGS.

room at 10:30 A.M. Since there are 750,000 cu. ft. of air in the room and there are 8.5 parts of CO_2 per 10,000, the total amount of CO_2 will then be

$$\frac{8.5 \times 750{,}000}{10{,}000} = 640 \text{ cu. ft.}$$

There were 12 men in this room during this hour and these 12 men gave off approximately 10 cu. ft. of CO_2; therefore, 10 cu. ft. are to be subtracted in all cases except the first (which is the starting point). In this manner the following results were obtained:

640 cu. ft. of CO_2 at 10:30
440 cu. ft. of CO_2 at 11:30
350 cu. ft. of CO_2 at 12:30
305 cu. ft. of CO_2 at 1:30

These points were then plotted and the "Air Change Curve" drawn (Fig. 7).

Samples of outside air showed 3.5 parts of CO_2 per 10,000, or 263 cu. ft. of CO_2 to 750,000 cu. ft. of air.

At the beginning of the test there were 640 cu. ft. of CO_2 in the engine-room. Adding to this a complete air change we have 640 plus 263 = 903 cu. ft. of CO_2; this, however, is for a

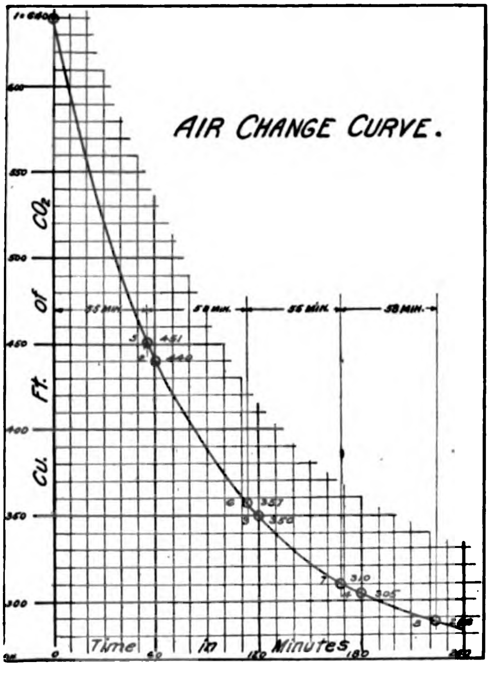


FIG. 7.—AIR CHANGE CURVE.

volume twice the size of the engine-room and we, therefore, divide by 2, giving 451 parts of CO_2 in the engine room after one air change has taken place. The point is plotted on the "Air Change Curve" and the time noted (55 minutes) which corresponds to this CO_2. The first air change took 55 minutes.

Add 263 cu. ft. to 451 cu. ft. and divide by 2 we have 357 cu. ft. of CO_2 at the end of the second change, which is 58 minutes after the first.

Add 263 cu. ft. to 357 cu. ft. and divide by 2 and we have 310 cu. ft. at the end of the third change, equal to 55 minutes after the second.

Add 263 cu. ft. to 310 cu. ft. and divide by 2 and we have 286 cu. ft. at the end of the fourth change, equal to 58 minutes after the third.

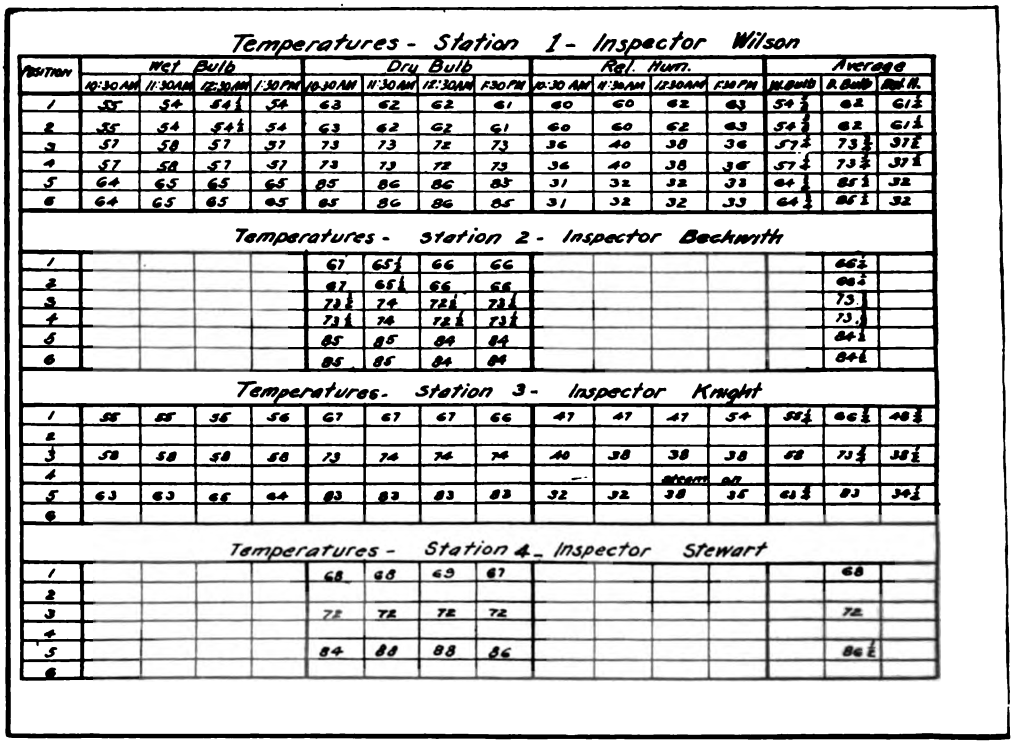
The average of these four changes is 56½ minutes, which means one complete air change in 56½ minutes.

HEAT LOSSES.

As will be noted in the cross-section of the building the material of construction varied at different elevations. On account of the height of the room there was a difference in temperature of 40° between the air at the floor level and in the peak of the roof. It is evident from this that in computing the heat transmission through the wall the temperatures to be used must be those corresponding to that part of the wall in question. For this reason temperatures were taken at various points and the "Temperature Curve" drawn (Fig. 9), which curve is approximately a straight line.

HOW TEMPERATURE CURVE IS USED.

To illustrate the use of the "Temperature Curve" let us take the windows in the east wall for example.



Temperatures - Station 1 - Inspector Wilson

Position	Wet Bulb				Dry Bulb				Rel. Hum.				Average		
	10:30 AM	11:30 AM	12:30 AM	1:30 PM	10:30 AM	11:30 AM	12:30 AM	1:30 PM	10:30 AM	11:30 AM	12:30 AM	1:30 PM	W. Bulb	D. Bulb	Rel. H.
1	55	54	54½	54	63	62	62	61	60	60	62	63	54⅜	62	61¼
2	55	54	54½	54	63	62	62	61	60	60	62	63	54⅜	62	61¼
3	57	58	57	57	73	73	72	73	36	40	38	36	57¼	73¾	37½
4	57	58	57	57	73	73	72	73	36	40	38	36	57¼	73¾	37½
5	64	65	65	65	85	86	86	85	31	32	32	33	64¾	85½	32
6	64	65	65	65	85	86	86	85	31	32	32	33	64¾	85½	32
Temperatures - Station 2 - Inspector Beckwith															
1					67	65½	66	66						66⅛	
2					67	65½	66	66						66⅛	
3					73½	74	72½	73½						73⅜	
4					73½	74	72½	73½						73⅜	
5					85	85	84	84						84½	
6					85	85	84	84						84½	
Temperatures - Station 3 - Inspector Knight															
1	55	55	56	56	67	67	67	66	47	47	47	54	55½	66¾	48¾
2															
3	58	58	58	58	73	74	74	74	40	38	38	38	58	73¾	38½
4									--		steam on				
5	63	63	65	64	83	83	83	83	32	32	38	35	63¾	83	34¼
6															
Temperatures - Station 4 - Inspector Stewart															
1					68	68	69	67						68	
2															
3					72	72	72	72						72	
4															
5					84	88	88	86						86½	
6															

FIG. 8.—TEMPERATURE READINGS AT DIFFERENT STATIONS.

The bottom elevation of these windows is about 14 ft.-10 in. and the top about 34 ft.-10 in., which gives an elevation of 24 ft.-10 in. for the center. The temperature which corresponds to 24 ft. 10 in. elevation on the "Temperature Curve" is 78° and this is assumed as the inside temperature. The outside temperature for this point is 65°, which gives a temperature difference of 13°. This method was used throughout the following computations:

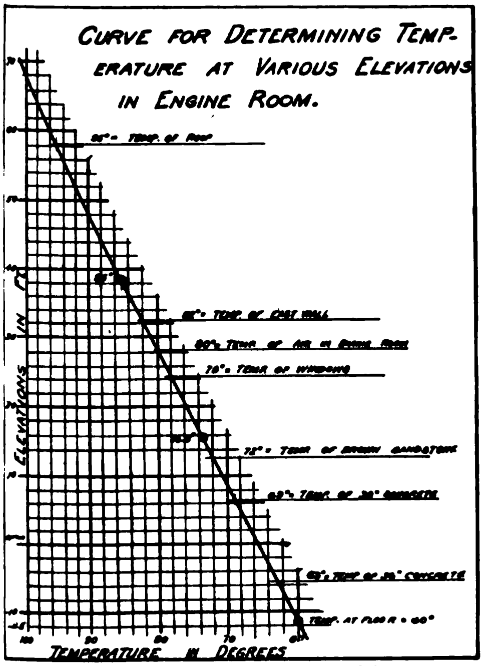


FIG. 9.—TEMPERATURE CURVE.

Heat Loss Through Walls:

Volume = 170 x 67 x 73 = 831,470 cu. ft.
Deduct for machinery 83,170 cu. ft.
748,300 cu. ft.
say 750,000 cu. ft. net air change.
Area of floor = 170 x 67 = 11,400 sq. ft.
5,400 sq. ft.
6,000 sq. ft. net exposed floor area.

Floor:

3-ft. concrete on 2-in. waterproof topped with ½-in tile.
½-in. tile coef. = 0.31.
3 ft. concrete coef. = 0.22.
2 in. pitch coef. = 0.40.

$$\text{Coefficient} = \frac{1}{\frac{1}{0.31}\ \frac{1}{0.32}\ \frac{1}{0.40}} = \frac{1}{10.28} = 0.098.$$

Temperature of floor = 60° F.
Temperature outside = 45° F.
6,000 x 0.098 x 15 = 8,800 total B. T. U. loss.

Roof:

Area 80 x 170 = 13,600 sq. ft.
3-in. T and G. yellow pine, slatters' felt and slate Coef. = 0.25.
Temperature of roof = 95°.
Temperature outside = 64°.
31°.
13,600 x 0.25 x 31 = 105,400 total B. T. U. loss.

East Wall: Facing Lake Michigan, with no building intervening.
Basement wall, 3 ft. concrete with 2 in. pitch
from — 11.5
to + 4.13
15.63 ft.
Coef. = 0.14.
Length = 170 ft.
Temperature difference = 63° — 45° = 18°
15.63 x 170 x 0.14 x 18 = 6,600 B. T. U. loss.

From elev. + 4.13 to + 9.87 = 5.74 ft.
30-in. concrete with 2-in. ptch. Coef. = 0.15.
Temperature difference = 69° — 45° = 24°.
Length of wall = 170 ft.
5.74 x 0.15 x 24 x 170 = 3,530 B. T. U. loss.

From elev. + 9.87 to + 14.87 = 5 ft.
25-in. brown sandstone. Coef. = 0.30.
Temperature difference = 72° — 64° = 8°.
Length of wall = 170 ft.
5 x 0.30 x 8 x 170 = 2,040 B. T. U. loss.

Windows—Seven at 10 ft x 20 ft. = 1400 sq. ft.
Each window = nine lights 30/69. Coef. = 0.90.
Temperature difference = 78° — 65° = 13°.
1400 x 0.90 x 13 = 16,380 B. T. U. loss.
From elev. + 14.9 to + 50.3 = 35.4 ft.
25-in. brick wall. Coef. = 0.20.
Temperature difference = 82° — 65° = 17°.
35.4 x 170 = 6018 sq. ft.
less 1400 sq. ft, windows.
2618 sq. ft. net.
4818 x 0.20 x 17 = 15,700.

Total for East Wall = 44,250 B. T. U.

South Wall: 67 ft. long, facing Montrose Boulevard, elevation and coefficient of structure same as for East wall.
3-in. concrete = 15.63 x 67 x 0.14 x 18 = 2646 B. T. U. loss.
30-in. concrete = 5.74 x 67 x 0.15 x 24 = 1392 B. T. U. loss.
25-in. sandstone = 5 x 67 x 0.30 x 8 = 800 B. T. U. loss.
Windows (two at 10 ft. x 20 ft.) = 400 x 0.90 x 13 = 4680 B. T. U. loss.
Gable Windows, 3½ x 7 ft. = 75 sq. ft.
Coef. = 0.94.
Temperature difference = 90° — 64° = 26°.
75 x 0.94 x 26 = 1820 B. T. U. loss.

Transom:
12 x 5 ft. = 60 sq. ft.
Coef. = 0.95.
Temperature difference = 78° — 64° = 14°.
60 x 0.95 x 14 = 800 B. T. U. loss.

Door:
12 x 12 ft. = 144 sq. ft.
Coef. = 0.50.
Temperature difference = 75° — 64° = 11°.
144 x 0.50 x 11 = 792 B. T. U. loss.
25-in. brick wall = 25.4 x 67 = 2371 sq. ft.
less door and windows = 681 sq. ft.
1690 sq. ft.
Area of gable 710 sq. ft.
2400 sq. ft.
240 x 0.20 x 18 = 8640 B. T. U. loss.
Total for south wall = 21,570 B T. U. loss.

North Wall: Protected by a coal-storage building 15 ft. away.
Same as south wall = 21,570 B. T. U. loss.

West Wall: Against boiler room.
Temperatures in boiler room were found to practically balance temperature in engine room, hence no heat transmission.

HEAT LOSS DUE TO AIR CHANGE.

From the accompanying air-change curve (Fig. 7) it was found that one complete air change took about 56½ minutes.

The average temperature in engine room (Fig. 9) = 80°.

Temperature of entering air = 65°.

B. T. U. required to raise 1 cu. ft. of air from 65° to 80° = 0.267.

$$750{,}000 \times 0.267 \times \frac{60}{56.5} = 213{,}000$$

B. T. U. per hour.

Total Heat loss = Total Heat Supplied.

Floor	8,800
Roof	105,400
East Wall	44,250
South Wall	21,570
North Wall	21,570
Air Change	213,000
Total	414,590 B. T. U.

Since only three engines were operating throughout the test, each engine and its accessories furnished 414,590/3 = 138,200 B. T. U., or 138,200/970 = 143 lbs. of steam at 2 lbs. pressure per engine, equal to 143 x 4 = 572 sq. ft. of cast-iron direct radiation. This equivalent was used for each engine in calculating net radiation required for the Mayfair plant.

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The Engineers' Place in the Sun.

A complaint that the engineer is getting more than his due share of government work these days is made by the *Architectural Forum,* which devotes several pages of its March issue to letters from architects on the theme of how architects can gain a larger recognition. This will sound like music to men in the heating trade who have felt that the situation was just the reverse, at least as far as the general public is concerned.

"When our government entered the war," says the *Architectural Forum,* "and began preparations on a large scale for its prosecution, it was thought quite naturally that the achievements of the architectural profession would be an appreciated guiding post and that the preparation of the government's building plans would be placed in the hands of architects. Were they? No. Engineers and contractors who furnished the 'know how' were given precedence, while architects were dismissed as visionary artists."

In the letters sent in, one correspondent states: "The closest competitor of the architect today (except perhaps the other architect) is the engineer, and the next in order is the decorator. Can the engineer design better industrial and commercial structures than can the architect? Not if the architect is a real architect. The real architect can and does put into his product a basic element necessary to the larger life which neither of these others can, in the very nature of things, supply. Could the engineer solve his problem in the spirit of beauty, he would cease to be an engineer and become an architect."

Another correspondent writes:

"Let us attempt first to determine what the most complicated and difficult building operations are. Take the great bridge over Hellgate. It is a question of study of conditions to determine the type of bridge, the position of piers, the foundations, the span, the details of the truss. Take as a comparison the New York Municipal building. This involves every engineering problem of foundations and steel, and in addition the most comprehensive and detailed study of every department to occupy the building, the economical arrangement of the plan for the efficient execution of the work, corridors and elevators for service, and problems of heating, ventilation, power, electric service, and plumbing, and in addition to this that knowledge of design which makes it possible to weld this complete mass of detail into an harmonious whole. The first is simple compared with the second. The first is typically an engineering piece of work, the second is typically an architectural one.

"Or, to take more everyday comparisons, a manufacturing plant, or mill, and a hospital. The one requires the study of one unit or bay for certain requirements of light and for certain floor loads, and then the duplication, with perhaps modifications for special uses or loads of this bay—the study of heat, power, and its application and use. The other requires study of all the structural problems of the mill, and in addition study of all details connected with patients, nurses, doctors, and servants, details of operation, administration, and service. Again these must be coordinated, harmonized, and brought to a logical and therefore beautiful conclusion. Again, the first is rather in the province of the engineer, while the latter is in that of the architect. The first is simple, the second is complicated. Moreover, it is to be noted that the architect could readily do the former, indeed would consider it very easy; while the engineer would find the latter very difficult if not impossible, because his engineering training has not taught him how to do it.

"Let the layman in any large center consider some of the important building operations of which he knows and see whether without an architect such undertakings would have been possible.

"Put briefly, when it is a question of building, it is the simpler, less complex problems which the engineer solves; it is the complex ones, often involving the engineers' problems as well, which the architect handles."

The inroads being made into the architectural profession by contracting companies is referred to by another correspondent who states: "While every day is seeing a new raid on what architects have fondly imagined to be their own particular domain, made either by the engineers or by interior decorators, or landscape artists, or contracting companies, it is too petty a business for the Institute (of Architects) to concern itself with chastening the small-town practitioner who squares the local paper by inserting his card. While the architects have been saying 'After you, my dear Alphonse,' to each other, certain pawky and hard-headed engineers who care about as much for ethics as they would for an old cellar wall which might come in the way of their operations, have developed selling organizations for plans, buildings, and all which are rapidly undermining the ground beneath the architects' feet. While the architects have been busy perfecting a new standard contract, which shall be more equitable for the suffering contractor, the latter has, without consulting them, gone ahead with his 'cost plus' propaganda, which absolutely assures him against loss and shifts all the risk over onto the owner."

Still another correspondent proposes that "the American Institute of Architects, or any representative body, consult with the engineering socieies or contractors' associations and agree upon a line of separation of activities, or upon a degree of co-operation."

Finally a Western architect laments the fact that "in all building in recent years the credit for speed in construction has been taken by the contracting firms, who have advertised the fact extensively. They have dwelt at length on 'wonderful organization,' 'wonderful systems of accounting;' they have invented or adopted terms and titles, such as 'Industrial Engineer' and 'Efficiency Engineer or Expert,' and they have assumed full and public responsibility for their success in every instance, and admit its direct relation to the great organization they have built up.

"The architect has indulged in no advertising. He even doubted the propriety of allowing his name to be included in smallest letters on the blatant signs by which the contractor announced that he was 'it.' He has taken no credit for the building under construction, even though its speed and success were as much, or more, due to him as to the contractor. The public thinks the term 'designed by an architect' relates only to some senseless ornamentation or detail, and not at all to the conception of the building in plan, arrangement, construction or composition, or to its success as a solution of a difficult building problem.

"Moreover, the architect has, by the nature of his work and by his ideas of professional practice, isolated himself from a direct and absolute knowledge of building costs and responsibility for them. He has assumed an advisory position, and for real ideas of cost has deferred to the construction companies. He has not assumed to have financial responsibility—it is therefore assumed that he has none. He has not assumed to have knowledge of exact building costs—therefore he is not considered a judge. This idea has been unduly advertised by stories, sometimes true, of exceeded appropriations, always without a statement of the causes."

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A. S. ARMAGNAC....................*President*
GUSTAVE PETERSEN....*Secretary and Treasurer*

A. S. ARMAGNAC, Editor
GUSTAVE PETERSEN, Business Manager
HAROLD L. ALT, Contributing Editor

European Representative:
W. G. HOLLINWORTH, 304 High Holborn
London, W. C.

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IT IS now evident that the proposed research bureau for the establishment of proper methods and standards for heating and ventilating work has passed beyond the talking stage. Concrete plans have been whipped into shape and the manufacturers and dealers will shortly be given the opportunity of doing their share in financing the project. That it is a distinct opportunity for them may easily be shown.

In the first place it will broaden this field immeasurably. It is no exaggeration to say that at the present time the limitations of the industry, especially on the ventilating side, are being profoundly affected by the suspicion in high quarters that the expensive equipment required by present standard practice is not giving results commensurate with its cost. Today, for instance, in the city of Buffalo, the authorities are considering a new system of heating and ventilation for its more important school buildings based on the conviction that the apparatus installed, some of which at least is modern, does not meet the requirements. Everyone is familiar, also, with the publicity recently given to the tests made by the New York State Commission on Ventilation which give window ventilation a remarkable endorsement in the prevention of respiratory diseases. In short the trend is not towards the wider adoption of the present elaborate types of apparatus.

In the second place, the research bureau may be expected to standardize many of the present practices for given classes of work, if not the apparatus itself, and this will serve to stabilize the industry by eliminating freak constructions and giving the manufacturers a more definite basis for gauging the necessities of the market and their own output.

Finally, the crying need for the work will never be met unless the manufacturers stand squarely behind it and give it their support. It needs no argument to show that the engineers by themselves have never been able, and less so now than ever, to take up the work on an adequate scale, although the initiative properly belongs to them and their findings will have far greater weight than if made by the manufacturers alone.

The manufacturers, as a class, have long since proved their sincerity to the cause of good engineering and there is no reason to doubt that they will back up this new line of research work with the same enthusiasm and devotion that they have shown in perfecting the design and construction of their individual products.

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ARE you co-operating in the plans for building bigger business by going after "new equipment for old buildings?" Read the Trade Extension Committee's four-page insert in this issue. It reflects a careful study of the situation. Prompt action means not only more individual profits but a boost to the trade at a critical time.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Research Bureau and Fuel Limitation Projects Advanced at Buffalo Meeting, June 26-28, 1918

Rules for limiting the supply of coal to domestic consumers next winter, which may be adopted and put into effect throughout the country by the United States Fuel Administration were advanced to their final stages at the summer meeting of The American Society of Heating and Ventilating Engineers, in Buffalo, June 26-28, 1918. They will now be submitted to the Bureau of Mines and, if approved by that body, will be turned over to the United States Fuel Administration. Both of these departments have signified that the Society's suggestions on this matter will be welcomed and given the utmost consideration.

FREDERICK R. STILL
President, American Society of Heating and Ventilating Engineers.

The rules, while not given out for publication pending further possible alterations, follow, in a general way, those proposed at the annual meeting of the Society and provide roughly for one ton of coal per room per month during the heating season for house heating systems and limited supplies of coal for cooking depending on the number of persons in the household.

Further progress was also made in the Society's plans for a research bureau. It is expected that the raising of funds for maintaining the bureau will be taken up this summer and the bureau started possibly before winter. Owing to the equipment and facilities of the Bureau of Mines' testing station in Pittsburgh it is probable that the Society's principal researches will be conducted at that bureau.

The war cut down the attendance somewhat. The programme, however, was a full one and many of the papers brought out lively and interesting discussions. This was particularly true of the drying session.

An attendance of 120 members and guests was registered.

Morning Session, June 28.

Mayor Buck welcomed the society to Buffalo. He congratulated the society on its work, especially in the field of fuel conservation, which was calculated to make the society's activities of national interest and importance. Buffalo, he said, had figured large in the history of the United States, having been burned by the British in the Revolutionary War, while in the Civil War the city had a record of having enlisted every male citizen in that struggle. Buffalo's slogan today is "Buffalo Never Fails," and the members may rest assured that Buffalo will not fail this time in its welcome and entertainment of the members.

H. G. Issertell responded to the mayor's welcome.

President Still announced that the proposed session on district heating had to be given up, owing to difficulties in making the necessary arrangements with the National District Heating Association.

He then presented a paper which he described as a "bombshell."

PROPOSES CHANGE IN NAME OF SOCIETY

President Still proposed nothing less than a change in the name of the society to embrace the extended field of activities now covered in the work of its members. Mr. Still proposed some such name as the "American Society of Consulting Engineers."

The war, he said, has already shown what engineers are made of. There is no other profession which has done so much with so little notice taken of its achievements. Engineers, he said, are to blame for this condition.

He declared that after the war engineers should proceed to take part in the world's political affairs. They will need to run the country during the reconstruction period.

He said there was a distinct danger of agitators taking possession of the country with the possibility of an economic and political breakdown. Engineers must not think it unethical to mix in public affairs.

It was at this point that he suggested changing the society's name. Heating engineers are now exercising the functions of consulting engineers and are coming to have charge of the entire mechanical equipment of buildings. He differentiated between the mechanical engineer and the consulting engineer by classifying the former as the designer of functional apparatus while the consulting engineer's province is the application of such functional apparatus.

The proposed change of name, he added, would widen the scope of the society's work and would result, among other things, in attracting a much larger membership.

President Still went even further and suggested that the society get in touch with commercial organizations in the heating field and co-operate with them in the making of tests and establishment of standards. Such organizations, he said, could be represented in the society by bureaus.

The proposed "American Society of Consulting Engineers" would embrace, not only heating and ventilating engineers, but mechanical, electrical and chemical engineers whose work is embraced in the mechanical equipment of buildings.

A communication was read from the United Association of Steam Fitters announcing that they had appointed two delegates to represent the association at this meeting. This is the first time this action has been taken, and the delegates were given a hearty welcome by President Still.

REPORT OF FUEL CONSERVATION COMMITTEE.

J. I. Lyle presented the report of the Committee to confer with the Bureau of Mines, with special reference to the development of a rule for allotting coal for house heating during the coming winter. The committee's report was not given out for publication pending its consideration by the Bureau of Mines.

One speaker emphasized the importance of stopping the air leaks in the chimneys. He also stated that the fire combustion temperature is a better index to the conditions in the heating system than the stack temperature. He gave a number of instances where the construction of the chimney was faulty.

Mr. Collamore said that many people

accustomed to burn hard coal would be compelled next winter to use bituminous coal and that they should, therefore, be exempted from the smoke ordinances.

Mr. West said that the personal equation was the determining factor in the coal requirements and that the amount of coal used, either north or south, depended to a large extent on the man running the heater.

Mr. Timmis urged the endorsement by the society of the committee's plan for the conservation of fuel. On his motion, it was voted to approve the general plan of the committee in proportioning coal. A rising vote of thanks was extended to the committee, which included J. Irvine Lyle, chairman; George W. Martin and Perry West.

PUBLICATION OF CHAPTER PAPERS

President Still brought up the question of the rights of the chapters in publishing papers read before the chapters before they had been submitted to the society's publication committee. An amendment to the society's constitution was proposed providing for the appointment of publication committees of the chapters so that, under certain conditions, such papers or addresses could be released immediately for general publication. This proposed amendment will be voted on at the next annual meeting of the society.

The first professional paper was then presented on "The Heat Transmission of Standard Building Materials" by A. C. Willard. The substance of this paper, was published in a recent bulletin (No. 102) of the Engineering Experiment Station of the University of Illinois.

It was voted to refer the paper to the society's committee on research bureau with instructions to prepare a comparative table showing how closely the constants given by Professor Willard coincide with those in general use.

A report was presented of the work of the Chicago Commission on ventilation. Samuel R. Lewis, a former president of the heating engineers' society, is now president of the commission. A list was given of the tests already made by the commission which are being published in THE HEATING AND VENTILATING MAGAZINE, as well as those the commission has in prospect. Those completed and still to be published include the following:

Korshak Workshop: A test of the air conditions in a ladies' tailoring establishment located in a basement.

Chicago and Cook County School for Boys: A test of the ventilation of a school building equipped with direct-indirect radiators and exhaust mechanical ventilation.

School Heating and Ventilation: An application of the observations made by the Commission.

A Ventilation Paradox: A paper describing the use of air for ventilating purposes, this air being derived from a deep freight tunnel.

Ventilation of the General Office Buildings of Two Railways: A test carried through an entire heating season for developing comparative results obtained with the natural ventilation installed in one of these buildings, and the mechanical ventilation installed in the other.

Further studies of the operation of the experimental room at the Chicago Normal School.

A study of the ventilation and heating of open-air schools as compared with the ordinary schools.

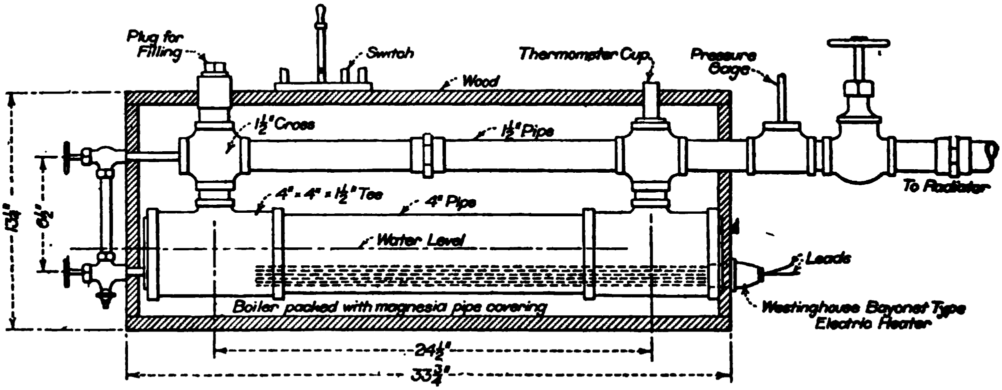
Afternoon Session, June 26.

The representatives of the United Association of Steam Fitters were introduced by President Still. They expressed the hope that opportunity would be found for closer co-operation between the two organizations, one of the delegates, Mr. Cook, referring especially to the many examples which he had found in Chicago of poor heating installations.

Professor J. E. Emswiler then presented a paper on "Electrical Method of Testing Radiators."

The Electrical Method of Testing Radiators.

Professor Emswiler presented details of the methods used at the University of Michigan for testing radiators by electrical means, using an electric heater to generate the steam consumed by the radiator and the determination of the heat required for this by measurement of the energy consumed in the heater. A series of tests was made on a 38-in. 3-col. 12-section cast-iron radiator using first the electrical method, and afterwards the steam method. All the tests were made in the same room, with all conditions as nearly alike as possible.



APPARATUS FOR TESTING RADIATORS BY ELECTRICAL METHOD.

For the steam method the value of K (B. T. U. per hour per square foot per degree difference), averaged for the tests, was 1.643. For the electrical method the value of K, averaged for the three tests, was 1.661. Curves were included showing the observed values of the most important quantities, as plotted during tests. These curves, it was pointed out, are valuable for indicating when conditions become constant. They also show the different effects of the two radiators on the distribution of temperature within the room. On the whole, stated the author, the electrical method is superior to the steam method of testing radiators.

In the discussion James H. Davis brought up the results of tests conducted by Professor Emswiler on cast-iron and pressed steel radiators in which the steam consumption in the cast-iron radiators was greater without any better heating effect than with pressed steel radiators. Professor Emswiler stated that he had not been able to account for this difference.

Thomas Chester, engineer for the American Blower Company, presented a paper on "Ventilation of Mines."

Ventilation of Mines.

Mr. Chester's paper was one presented at the March meeting of the New York Chapter. It was a very complete review of the development of mine ventilation in this country and reflected the author's familiarity with this line of work. Commenting on the general subject of coal mining, he said that "no doubt at some future time the internal heat of the earth will be made use of for heating factories and residences and it seems absurd to keep such a large army of men at work digging out coal when a few shafts in each city driven down from 5 to 10 miles would furnish all the heat necessary by allowing water to descend to the heated interior to be turned into steam."

The majority of mines are equipped with fans which either deliver air to or exhaust it from the workings. Most mine fans are made reversible. The amount of air used to ventilate a coal mine is usually from two to three times the weight of the coal taken out in a given time. Explosions in mines are produced by ignition of methane in most cases and this is greatly intensified by the subsequent immediate combustion of the dust.

The point of paramount importance is to ascertain the resistance which the mine will offer to the required volume of air. The required volume is calculated by making allowance for the number of men and animals in the mine and by additional allowances for removing gas. Coal is mined usually from seams at some distance below the surface and it is necessary to bore shafts to get to the coal. In such cases the resistance will vary from 1 in. to 6 or 7 in.

State laws usually call for 150 cu. ft. of air per minute per man in non-gaseous mines and 200 cu. ft. per man in mines producing a good deal of gas. The allowance for mules is usually 500 cu. ft. per minute per animal. The friction of airways is the cause of mine resistance. The friction is calculated by the formula:

$$F=KSV^2$$

where K = a suitable coefficient; S = the total square feet of rubbing surface or perimeter multiplied by the length of airway; and V^2 = the velocity in feet per minute squared. The coefficient most extensively used is that recommended by Fairley, which is 0.000,000,01.

Mr. Chester also discussed the testing of mine fans.

Mr. Timmis suggested that in accordance with the larger scope of the society's activities as proposed by President Still in his address, the society should go on record as advocating the wider enactment of mine ventilation laws. A motion to this effect was passed.

President Still said it was a very difficult matter to determine the air flow in a mine.

Frank K. Chew suggested that Mr. Chester's paper be brought to the attention of the mining engineers' society.

Mr. Lyle said the greater number of explosions in coal mines was in the winter time. This, he said, was due to the dryness of the air. Attempts to moisten the air by the use of steam had been tried.

Mr. Chester said numerous attempts had been made to moisten the air, but that it was necessary to heat the air to prevent condensation so that it became a difficult proposition inasmuch as upward of 1,000,000 cu. ft. a minute are frequently handled in mine ventilation.

A topic was brought up on the question of the flow of condensation in a one-pipe system when the steam flow exceeds 15 ft. per second. Mr. Chester thought that a velocity of 20 ft. a second would be about the limit, based on experiences with the pneumatic transportation of materials where the required air flow is usually at 1200 ft. per minute.

WINDOW VENTILATION VS. MECHANICAL VENTILATION.

Another topic was the comparative advantages of window ventilation and mechanical ventilation. President Still spoke of the publicity being given to the ideas of the window-ventilation advocates and thought the society should take some definite stand on the subject.

Mr. Davis stated that the tests of the Chicago Commission on Ventilation in this line of work showed that buildings mechanically-ventilated give better results than with open-window ventilation.

Perry West spoke of the results obtained by the New York State Commission on Ventilation which showed fewer respiratory diseases with open-window ventilation. These results, he said, were misleading, as, for instance, a study of the tests indicated that the rooms with open-window ventilation were kept at about 68°F. while those with mechanical systems were usually at 70°. This alone, he said, might account for the difference noted.

Mr. Timmis said it was unfortunate that the society had not been represented in the tests made by the New York State Commission, as modifications, especially in the technical data, might have been found necessary that would have harmonized the results with those usually observed.

In reply to a point made by one speaker that people in Siberia live in tight houses during the cold weather, President Still said that the answer to such a practice was the appalling death rate from tuberculosis in that country. Moreover, at this time, when fuel conservation is being practiced, the use of open-window ventilation is manifestly out of the question.

Frank K. Chew proposed the appointment of a committee on propaganda or a lecture committee to bring the elements of good ventilation to the attention of the general public.

Under topical discussion, the subject was introduced of "The Use of Independent Air Heater Units for Factories, Warehouses and Large Interior Spaces."

H. F. Rosenow explained the construction and operation of the Baetz air heater, a description of which was published in THE HEATING AND VENTILATING MAGAZINE for January, 1918.

In answer to a question as to the advantages of this system when four or more units are necessary, Mr. Rosenow said the cost would be less with the individual units than with the ordinary fan blast system.

Another unit system was described by Thomas Chester and illustrated by lantern slides.

President Still said the principal usefulness of the unit heater was in buildings already built with perhaps no provisions for heating and, in some cases, in extensions of buildings.

In answer to a question Mr. Rosenow said that it was not unusual to blow a distance of 500 ft. with the unit heater. Mr. Still said this could be done provided the ceiling was not too high. Mr. Rosenow said this was contrary to his experience and cited a building with an interior height of 87 ft. which is being satisfactorily heated in this manner, with little variation in temperature.

Announcement was made of the election of the first woman to junior membership in the society, Miss Helen Innis, of New York. Miss Innis was present and was welcomed by President Still. She responded, thanking the society for its action.

Morning Session, June 27.

A report of the Research Committee was presented at the opening of the morning session. This is the committee in charge of the plan for establishing a laboratory by the Society to develop definite heating and ventilating standards and methods.

Perry West presented the report. He said it was proposed to call it "Research Bureau of the American Society of Heating and Ventilating Engineers," to be conducted under the supervision of a standing directing committee of the Society. A director will be necessary.

The plan is to co-operate with the United States Bureau of Mines and educational institutions. All of the bureau's conclusions are to be put out as the official conclusions of the Society.

Mr. West outlined the plan which included the determination of proper heating and ventilating conditions and the determination of the best method of maintaining such conditions. It is also planned to place the most commonly-used systems upon a more scientific basis.

Fuel burning will occupy an important place in the work of the bureau, while an attempt will also be made to establish a more scientific basis for the factor of heat losses, radiator efficiencies, natural air changes, pipe sizes and the determination of factors for air duct design.

Finally, unusual conditions in such structures as tall office buildings, and factories, will be considered, as well as intermittent heating service.

It is estimated that the cost of conducting the bureau will be $10,000 per year. It is proposed to raise this sum by pro-rating the cost among manufacturers of heating and ventilating apparatus. The plan is to raise enough funds at the outset to carry on the work for a period of five years. According to present plans the campaign for raising the necessary funds will be started this summer.

It is proposed to make arrangements with the testing plant of the Bureau of Mines in Pittsburgh for making the principal tests, although efforts will also be made to extend the scope of the work to universities and colleges.

DRYING SESSIONS

The session on drying was opened with a paper by W. A. Perry on "How Food Will Win the War."

How Food Will Win the War.

Mr. Perry pointed out that the big problem of the United States Food Administration is not that of prices, but the distribution of the available food supply. Perhaps his most significant statement, as far as the heating engineer in concerned, as offering possibilities for drying work, was that "over against our shortage of wheat, meats, fats and sugar, we have abundant resources in corn, potatoes, vegetables, fish and poultry. For various reasons these products cannot be economically shipped to Europe. In some cases the bulk is too great, in other cases the products will not keep in transit, and in the case of corn, we find that the Europeans have not yet been educated to its use."

H. C. Gore, chemist with the Department of Agriculture, then addressed the meeting, describing the progress made in the drying of vegetables since his previous report at the Society's January meeting.

Dr. Gore spoke first of the possible saving of freight, amounting, in the case of dried tomatoes, to 99%. There is also the enormous saving in space. The department has been working on the laboratory phase of the problem, with special reference to the proper moisture content of vegetables dried raw. It is much cheaper, he said, to dry vegetables in a raw condition.

Unless the dried product is brought to a proper moisture content there will be deterioration. The department is now in a position to state the proper moisture content for both raw-dried and cooked-dried vegetables, and to tell the effect of heat on these products. The result of its findings will shortly be published in bulletin form.

With cooked vegetables not so much drying is required. Dr. Gore distributed charts showing the effects of temperature and time on the quality of the dried product.

The department has developed a type of dryer known as the "general purpose" dryer. It has not as yet gone into the matter of drying fruits.

Professor Cross of Cornell University told of the difficulties in drying potatoes. When sliced the slices are apt to stick together. They must also be thin, and must be properly cooked. He said there is still lots to learn about drying potatoes and he urged those interested to take up one particular product like potatoes and specialize on that one problem.

In answer to a question Dr. Gore said rapid air movement through the dryer serves to give a uniform velocity. It has not yet been determined what is the effective length of dryer.

VACUUM DRYERS

Nathan Owitz, of the J. P. Devine Co., addressed the meeting on the possibilities of the vacuum process in drying both fruits and vegetables. He said that while the first cost of such apparatus is higher, the operating cost is surprisingly low. All danger of burning the product is eliminated by the low temperatures carried. The usual practice is to boil the product in a vacuum of from 28 to 29 in. mercury, giving a uniform air temperature between 101° to 155° F.

President Still said that in some cases lumber is being successfully dried by the vacuum process.

One advantage brought out for the vacuum heating process is that the product is not discolored, a most important point in marketing the dried fruits or vegetables. B. S. Harrison stated that discoloration is not necessary in warm-air drying.

Announcement was made that a thrift kitchen is in operation in Buffalo in which both warm air dryers and vacuum dryers are in operation. The members were invited to attend a dehydrated luncheon where all the courses are made up of dried food. It was stated that it was almost impossible to distinguish the dishes from those made in the ordinary way. A party of 24 later visited the thrift kitchen and partook of a "dried" luncheon which proved excellent.

The preparation of such food for the table, however, is an important matter. This is a separate problem in itself, but can be easily handled by following the proper directions.

W. L. Fleisher presented a paper on "Food Dryers and the Use of Schoolhouses for Drying."

Food Dryers and the Use of Schoolhouses for Drying.

In this paper Mr. Fleisher amplified his ideas expressed at the February meeting of the New York Chapter urging the use of the heating and ventilating equipments in public school buildings throughout the country for the drying of food stuffs. In New York City alone, he said, there is actual apparatus sufficient to dry enough food to feed 2,000,000 men, three meals a day, every day that this apparatus is run. Although the drying of foods is a very old process, Mr. Fleisher stated that its development has been retarded principally by the lack of a commercial outlet for the product and by the idea that the drying of foods is a very complicated process. By using the school building equipments, as suggested, the author stated that fans, heaters, boilers and the trays or kilns and tunnels in which to place the food products, were really the only things required for this work, so that nothing new, strange or unusual had to be developed. The trays or kilns could be made of wood and in very simple ways, while the rest of the apparatus was practically ready for use.

It was Mr. Fleisher's idea that basement corridors in mechanically-ventilated school buildings could be turned into tunnel dryers by means of wooden partitions, or, where the corridors are narrow enough, only cut-offs and divisions would be essential. The heated air could then be blown into one end of the corridor and the duct blanked off with a damper beyond this outlet. At the far end of the corridor or tunnel, another damper could be placed and an inlet located at this point, with a connection taken from a point beyond the first damper back into the fan so that recirculation from the far end of the tunnel could be obtained. In many cases State and Federal building plants could be utilized in the same way.

In addition to a bibliography on food drying and dryers, the paper contained a table showing the chemical composition of fresh and dried vegetables which emphasized the fact that all vegetables contain from 70 to 95% of water.

On motion of Mr. Timmis it was voted to bring the substance of Mr. Fleisher's paper to the attention of the Department of Agriculture and of the United States Food Administration and to appoint a committee to draft a digest of Mr. Fleisher's suggestions to be sent to those bodies. President Still appointed as the committee, W. L. Fleisher, chairman; R. T. Coe and Dr. H. C. Gore.

On account of the amount of work required to prepare the vegetables and fruits for drying, Dr. Gore suggested that the proposition should really be developed as a cannery adjunct, because canneries have all the preparatory equipment.

Mr. Fleisher stated that the large hotels could well be used and Mr. Owitz said that one New York hotel, the Manhattan, had already been successful in preparing and drying vegetables, using the vacuum heating process.

On the topic of community dryers, a scheme for a community warm-air drying system was submitted by A. S. Kellogg.

Before the session closed a campaign for increasing the Society's membership was discussed. William F. McDonald said that all of the Chapters could greatly increase their membership while many cities, such as Washington and San Francisco, offered opportunities for the formation of new chapters. Professor Hoffman proposed institutional memberships, to be taken by colleges and universities and by manufacturing plants.

Afternoon Session, June 27.

After a delightful boat ride on Lake Erie to the Buffalo Canoe Club the afternoon session was convened in the club house directly over the water. Here amid mild breezes the papers of the afternoon session were read and discussed.

Professor J. D. Hoffman presented a paper on "Reasons for Failures of Heating Systems," published on other pages of this issue.

Mr. Fleisher said the Government housing commission is now engaged in building thousands of workmen's homes, most of which are of a permanent character. The houses, as a rule, are heated by warm-air furnaces. He suggested that the recommendations contained in Professor Hoffman's paper be brought to the attention of the housing commission.

On motion it was voted to send copies of the paper to the Associated Press, American Press Association and to the leading dailies of the country. Mr. Lyle moved the appointment of a committee to edit the paper for general publication. This was later amended to include all the papers of the meeting suitable for general distribution. President Still appointed as a publicity committee for this purpose, A. S. Armagnac, chairman; Frank R. Chew and Professor J. D. Hoffman.

Mr. Chew suggested more activity by the chapters in getting local publicity for the Society's work. A statement that the fault often lies with the architect for poor structural conditions in connection with the installation of heating apparatus brought out a rejoinder from Mr. Collamore that the owner himself was more often the responsible party.

A paper was then presented on "A Campaign for Fuel Economy in House Heating," by C. W. Baker.

A.S.H.&V.E.
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HEATING ENGINEERS AT BUFFALO CANOE CLUB, BUFFALO, N. Y., JUNE 27, 1918

A Campaign for Fuel Economy in House Heating.

Mr. Baker's principal recommendation referred to warm-air furnace heating. His suggestion was the addition of an auxiliary cold air duct by which the air supply to the furnace may be taken from inside the house, instead of from outdoors, during very cold or windy weather. Although there is nothing novel in this, he said that only occasionally are furnaces installed in this way.

He urged the heating profession to inaugurate a campaign to carry out this work on a large scale.

This was followed by a paper on "Economy in Heating," by Konrad Meier.

Economy in Heating.

Mr. Meier's observations were based partly on the conditions obtaining in such countries as Switzerland, where he is now located, where the standard indoor temperature is 64.4° F. The war regulations in effect last winter in Switzerland provided that such rooms should not be heated to over 60.8° F. and even this temperature, he said, "is now considered luxurious." For other rooms the standard has been reduced still further and the number of rooms that may be heated at all in one dwelling is restricted. The heating of halls and stairways is stopped altogether. Fall and winter vacations for school children have been extended. The saving of fuel through a general lowering of room temperatures by 5° F. may be about 20% to 25% of the normal consumption, an important factor being the reduced tendency to indraft and updraft. There would also be less dryness of the indoor air.

Intermittent heating was favored by the author with steam heat, although conditions must be considered in every case. The only question is whether fires should be banked at night or allowed to burn out. For outdoor temperatures down to 40° F. the latter has been found more advantageous and is now in fact made compulsory (in Switzerland). Wherever wood is obtainable for restarting the fires every day, it will probably pay to stop them over night in most of the steam plants of moderate size until freezing weather sets in, providing the plant is ample to allow reheating within a reasonable time. With hot water heat, interrupted service ordinarily will pay only in mild weather.

Mr. Meier urged the wider use of coke as a fuel in place of anthracite. When of good quality it gives little ash and clinker. Its principal disadvantage with boilers intended for coal lies in the bulk, which requires an ample fire box or more frequent charging. However, a deeper bed may be carried than with soft or hard coal. Coke, he said, may be mixed with anthracite or used alone in most boilers designed for the latter fuel.

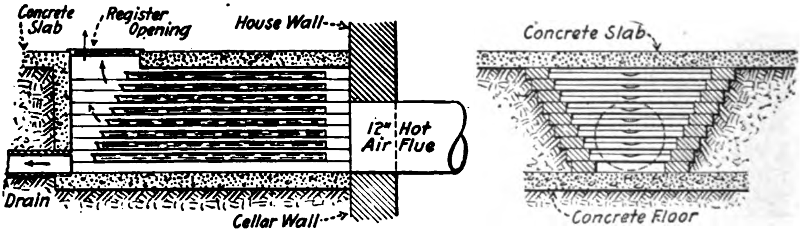
Mr. Meier urged the control of the draft in a heater mainly through the ash-pit, as, with the usual check drafts, an excess of air is handled in the flue at the cost of additional heat expended. This, it will be noted, is at variance with the suggestion offered by Professor Breckenridge at the previous meeting of the society to "take off the ash-pit door or never use it."

Regarding the discussion as to the best location of a radiator in a room, Mr. Meier said that such tests should also establish the best place for the radiator in reference to the amount of heat required to secure comfortable conditions for particular parts of the room, for instance near windows. It might be found, for example, that the interior location of high radiators calls for decidedly more heat than low single-column heating surfaces underneath the windows, because the former radiates less and heats more air, which rises to the ceiling and creates a current of cold air from the outside wall. The result is a cold floor and a ceiling, with considerable leakage overhead and indraft through doors and windows.

Mr. Meier also advocated better building construction and proper backing of radiators to prevent excessive heating of the walls behind.

A distinct disadvantage in discarding the ashpit door, it was pointed out, is the danger of causing gas to leak into the house when the fire is heavily checked by the smoke pipe dampers.

Mr. Carrier said that power plant practice offers the proper precedure to be followed. A balanced draft is the desired condition.



Longitudinal Section

Cross Section

ARRANGEMENT OF WATER PANS IN WARM-AIR OUTLET TO CONSERVATORY FOR MOISTENING AIR.

On the subject of warm-air heating, Mr. Chew proposed a committee to investigate the "pipeless" furnace and report to the Society on this type of heater. The matter was referred to the Society's furnace code committee with a request that a special report be made on it.

The final paper of this session was by C. W. Baker on "Reforms in the Design of Hot Air Heating Plants Needed to Compete with Other Systems."

Reforms in the Design of Hot-Air Heating Plants.

In this paper the writer stated that he desired "to present reasons why, by the use of intelligent methods in the design of a hot-air furnace plant, it can be made not merely the equal, but the superior, of either steam or hot water heating for all buildings of moderate size." One of the first essentials, he said, to secure a uniform distribution to the different hot air flues is to reduce the resistance to the flow of cold air to the furnace. In his own house, the cold air inlet from the outside, as well as a cold air inlet from inside the house, has a cross-section equal to the combined area of all the hot-air flues. The two cold air ducts join to form one channel leading to the furnace. At the point of junction there is installed a wing damper, which is adjusted according to temperature and wind. A large check valve, consisting of a light wooden frame covered with cloth was hung in the inside cold air intake to prevent short-circuiting from outdoors.

A small plant-room heated by this furnace has a special system for moistening its air supply. This is accomplished by the use of shallow rectangular pans of galvanized iron, 1 in. deep, made to fit on shelves made by the brick lining. These pans are filled from the plant-room hose. The author also advocated the wider use of blower systems for warm-air furnace operation.

Morning Session, June 28.

The final session was devoted mainly to full conservation. A paper on "Spontaneous Combustion" by W. M. Franklin was read by the secretary.

Spontaneous Combustion.

The growing necessity for the storage of coal to cover the needs of the coming winter gave special timeliness to this paper, which was an exhaustive treatment of the general subject of spontaneous combustion. Mr. Franklin first took up the principles of combustion which he discussed in clearly-expressed terms, showing that the amount of burning, or oxidation, is proportional to the amount of the substance exposed to the oxygen, and also proportional to the temperature. The more fibrous or the more finely divided a material, the more surface will be exposed to oxidation and, consequently, the greater will be the danger of automatic burning.

For the prevention of spontaneous combustion, the enclosing of the combustible substances in air-tight fireproof cans or other containers will usually be effective. Another method is to lay the susceptible material in a thin layer freely exposed to the air so that all the heat generated will be carried away quickly and the temperature of the mass saved from rising at any time. This method of procedure is suitable only for such substances as coal and sawdust when plenty of room is available. Materials may also be soaked with water although this may not be effective where oil is present, as this prevents the water from touching the surface of the fibres and at the same time supplies the moisture necessary for the combustion.

This was followed by "Notes on Spontaneous Combustion of Coal" containing the text of a bulletin issued by the Bureau of Mines.

Notes on Spontaneous Combustion of Coal.

Small coal piles, it was pointed out by the Bureau, rarely ignite from spontaneous combustion, so that it is to be recommended that coal be stored in small quantities as near the point of consumption as possible. If large storage piles are necessary it should be borne in mind that generation of heat is the result of slow oxidiation of the coal surface and that such oxidization is much more rapid from freshly-mined coal or from freshly-broken surfaces. The oxidiation rate increases rapidly with increasing temperature, and different coals have different oxidiation rates. It is therefore recommended that:

Where there is choice of coal to be stored, that having the lowest oxidizing rate should be chosen, if known.

Between two coals, that which is least friable, and therefore which presents the least total coal surface in the pile, should be selected.

The method of handling should be such as to produce the least freshly broken coal surface.

The coal should be as cool as possible when piled. Piping warm coal on a hot day is more likely to produce spontaneous combustion.

The coal must be kept from any extraneous source of heat.

Alternate wetting and drying of coal during piling is to be avoided if possible.

The fine coal, or slack, which furnishes the larger coal surface in the pile, is the part from which spontaneous combustion is to be expected. Piling of lump coal where possible is therefore desirable.

In the process of handling, if the lump coal can be stored and the fine coal removed and used immediately, the practice prevents spontaneous combustion in coals which would have otherwise given trouble.

The sulphur content of coal is believed by many to play an important role in spontaneous combustion. The evidence on this point is still conflicting, but to play safe, it is desirable to choose coal having a lower sulphur content, when choice is possible.

There is a current belief that dissimilar coals stored in one pile are more liable to spontaneous combustion. The evidence on this point is also conflicting, but to play safe, it is advisable to store only one kind of coal in a pile.

The ground on which a coal pile is built should be dry.

In order to carry away the heat as rapidly as produced, the following recommendations are added:

Coal piles should be so made that there is a ready movement of air for ventilation throughout all parts of the pile, especially when made of coarse lump coal. The surfaces of coal piles should be so exposed as to allow the pile to cool, or else the coal should be so stored that air circulation within the pile is very small.

In making a coal pile of mixed sizes, the coal should be so handled as to make a homogenous pile and prevent the segregation of coarse and fine coal. This frequently determines the most desirable machinery for unloading coal.

It is common practice to limit the height of a coal pile, this for two reasons:—A pile too high crushes the lower layers of coal, producing more fires; the larger the pile the less heat-dissipating surface there is exposed in proportion to the heat generating capacity of the pile. Twelve feet in height is a common limit.

TEMPERATURES

Whatever precautions are taken in choice and handling of coal, provision should be made for keeping track of the temperature rise in a coal pile and for rapid re-handling of portions of a pile in case of excessive heating. In a coal pile covering a considerable area, it should be so subdivided that in case of spontaneous combustion of a portion, the heat will not be transmitted to the whole pile, thus accelerating the heating of portions of the pile which normally would have remained cool.

To keep track of the temperature of coal piles, it is recommended that ½-in. iron pipes be driven vertically into the pile at distances of 15 or 20 ft. apart. A maximum thermometer lowered into the pipe to varying depths will indicate the temperature of the pile opposite the thermometer.

A survey of the pile and a survey of the temperature of all parts of the pile should be made twice a week during the first three months after the pile is made, and once a week thereafter until the pile has evidently ceased to heat. As soon as any portion of the pile reaches a temperature of 150° F., provision should be made for removing that portion of the pile. Actual removal need not begin until the temperature has reached 180°, but at these temperatures the rate of oxidation is dangerously rapid. The object of re-handling the coal is to allow it to cool below a dangerous temperature. Any method of re-handling which does not allow of cooling will only transfer the difficulty from the old pile to the new one. It is usually useless to employ water in an attempt to cool a coal pile.

Lack of provision for rapid reloading, cooling, and repiling of coal is the cause of serious loss from spontaneous combustion.

The heating of the base hospital at Camp Dodge was described in a paper by P. M. McConnell.

Heating the Base Hospital at Camp Dodge.

Camp Dodge, located near Des Moines, Ia., has a base hospital consisting originally of 40 buildings with a capacity of 500 beds. This capacity was found to be too small and it was enlarged to 2000 beds, requiring 71 buildings. The plans also provide for a future extension of 500 beds. Mr. O'Connell's paper gave a general description of the buildings and their equipment which includes 70,400 sq. ft. in the original hospital and 75,000 sq. ft. of radiation in the extension. High-pressure steam is used in the laundry, main kitchen and all diet kitchens, and also for heating all hot water. Numerous illustrations bring out the interesting details of the installation.

In the original scheme a steam pressure of 80 lbs. was carried on the main header from the boilers. A connection was then made to a 10-lb. low pressure header through a reducing valve. When the additional buildings were added and the boiler capacity increased, the reducing valve was removed as the additional load made it necessary to carry boiler pressure on all heating mains to the distributing points.

At various manholes, all steam lines connect into high-pressure headers which connect to intermediate distributing headers through reducing valves. In addition each building has a separate reducing valve for controlling the local pressure.

The return mains are run underground in tile conduits to the boiler house.

Suggestions prepared by the American Red Cross through D. C. McMurtrie, were incorporated in the last paper on "Duty of the Employer in the Reconstruction of the Crippled Soldier."

The Duty of the Employer in the Reconstruction of the Crippled Soldier.

This paper, which was one sent out for general distribution by the American Red Cross, emphasizes the fact that the only sound method of dealing with the crippled soldier or civilian is to train him for a trade in which the physical disability does not incapacitate him. In this country the Government will provide the necessary medical treatment, supply artificial limbs, conduct the training for an occupation, and find the job. It rests with the people, however, as to whether they will encourage the returned soldier to accept the advantages of training which will refit him for a life of usefulness and self-respect.

We must count on the return from the front of thousands of crippled soldiers, said Mr. McMurtrie. Industrial schools are now in operation by the hundreds in France, Italy, Germany, Great Britain and Canada.

Among the points brought out was that the education of the adult is made up largely of his working experience. The ground work of training in his past occupation must under no circumstances be abandoned.

The positive aspect of the employer's duty is to find for the disabled man a constructive job which he can hold on the basis of competency alone. Employers are urged, therefore:

To study the jobs under his jurisdiction to determine what ones might be satisfactorily held by cripples;

To give the cripples preference for these jobs;

To consider thoughtfully the applications of disabled men for employment, bearing in mind the importance of utilizing to as great an extent as possible labor which would otherwise be unproductive;

To do the returned soldier the honor of offering him real employment, rather than proffering him the ignominy of a charity job.

If the employer will do this, it will be a great factor in making the complete elimination of the dependent cripple a real and inspiring possibility.

Under topical discussion the subject of "Fuel Consumption Required for Operation of Air Washers" was taken up and the importance of humidity control emphasized. It was stated that some of the State fuel administrations are urging the cutting out of air washers on the ground that their use adds 50% to the fuel consumption in buildings where they are installed.

An invitation was presented from the Buffalo Academy of Medicine to send representatives of the Society to a meeting to be held that evening. A committee was named consisting of F. R. Still, Frank H. Chew and A. S. Armagnac, all of whom spoke later at the Academy of Medicine on the general subject of the relation of the medical profession to the work of the heating engineer.

R. C. Collamore presented a verbal report of the discussion on fuel conservation at the recent summer meeting of the American Society of Mechanical Engineers in Worcester, Mass. An item of information brought out at that meeting was that coal operators are to be penalized for delivering inferior grades of coal. Lack of time, he said, prevented a discussion of all the topics at that session.

The meeting then adjourned.

The Entertainment.

Under the leadership of C. A. Booth, general sales manager of the Buffalo Forge Company, a well-arranged programme was carried out. Following a matinee on Wednesday afternoon for the ladies, a reception and dinner, dance for members and guests was held in the ball room of the Hotel Statler. This attracted a large attendance, one of the features being a dancing competition in which the honors went to L. C. Soule and partner.

Thursday afternoon the entire convention party were taken on the steamer Americana across Lake Erie to the Buffalo Canoe Club at Abino Bay. After a professional session in the boathouse, the men rejoined the ladies and spent the time intervening before dinner in a remarkable game of one-old-cat on the beach.

The dinner that followed in the main club house was done full justice to, and the reputation of the Buffalo Canoe Club for good cooking more firmly established than ever.

The day seemed made for the occasion and after the dinner an hour of sheer enjoyment was spent on the clubhouse lawn and in walks along the beach. There was dancing later on the pier in which many participated.

Friday morning the ladies went by automobile to Niagara Falls where they had luncheon and later took the Gorge trip. Friday afternoon the men visited the plants of the Buffalo Forge Company and the American Radiator Company.

Included on the entertainment committee, which was given a special vote of thanks by the Society before adjournment for the success of its efforts, were C. A. Booth, chairman; J. A. Bendure, E. W. Case, W. G. Fraser, L. A. Harding, L. C. Soule and H. W. Wendt.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Annual Meeting of Michigan Chapter.

Captain Charles A. Ammerman of Camp Custer was the principal speaker at the annual meeting of the Michigan Chapter, held in Detroit, May 25. He described in detail the heating system at Camp Custer. President Frederick R. Still, of the heating engineers' society, also spoke.

New officers were elected as follows: President, J. R. McColl. vice-president, W. P. Verner; secretary, William F. McDonald; treasurer, H. A. Hamlin. Board of governors: James E. Degan, Thurlow E. Coon and Edwin L. Downs.

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Building permits for May, 1918, showed a smaller loss than for any previous month this year, as compared with the same period in 1918. The total operations in 116 cities, as compiled by the *American Contractor*, Chicago, was $49,941,778, as compared with $75,543,888 in May, 1917.

NATIONAL ASSOCIATION OF MASTER STEAM AND HOT WATER FITTERS

Twentieth Annual Convention, Chicago, June 3-5, 1918

Acting on a suggestion made at its last convention in Atlantic City, in 1916, the National Association of Master Steam and Hot Water Fitters has taken the important step of changing its name. According to a resolution passed at its recent annual convention in Chicago June 3-5, the organization will henceforth be known as the Heating and Piping Contractors' National Association.

EDMUND GRASSLER,
President Heating and Piping Contractors' National Association.

Patriotism was a dominant note at the convention, the flags of the Allies being prominently displayed in the convention hall, alongside the Stars and Stripes. At the same time a most serious matter in connection with Government work was taken up and frankly discussed. This was the practice of the Government in demanding that the general contractor shall himself construct all branches of the work, while in some cases the Government is hiring labor direct and executing the contracts itself. This practice, it was contended, deprives the heating contracting trade "not only of our means of existence, but has endangered our entire organization.

Competition and co-operation came in for their usual thorough discussion. As one step towards stifling unreasonable competition it was urged that the trade adopt the "open price" method of bidding whereby the bids of the contractors, after being submitted to the owner, general contractor, or architect, as the case may be, become known to every competing contractor. Further progress was also made in the development of a standard accounting system so that a clearer idea would be had of what constitutes "overhead expense," one of the advantages being that such "overhead" would be based on the same series of items. As President Almirall pointed out, "it will not do for one concern to place, say, his liability insurance as part of his overhead and another contractor to put that same item as part of his cost."

The possibility of the heating business being considered by the Government as one of the non-essential industries was brought up and the opinion was expressed that every care should be taken by the Government to prevent any serious curtailment of this industry. "The war will end some day," said

President Almirall, in his address, "and industrial enterprises will again become normal. When it does, these concerns will be needed and if, in the interval, they have been forced out of business, it will be a difficult matter to resume without very great loss." He proposed that, if necessary, the Government utilize such plants or "guarantee them a minimum return on their capital."

Monday, June 3, was taken up with meetings of the board of directors and of special committees at convention headquarters in the Hotel Sherman. In the evening the "Old Guard" consisting of the past and present officers and directors of the association, met in the hotel. There was a note of sadness in the re-union this year, as the "Old Guard" has lost no less than three of its members since its last meeting, including the late Alfred E. Kenrick, Paul H. Kendricken and John T. Sadler. A letter was received from W. G. LeCompte, who has for years been in charge of the entertainment features at the convention, and who is now on active military duty at the front.

President Juan A. Almirall called the convention proper to order Tuesday morning, June 4. He was given a rousing reception. After the singing of "America," President Almirall delivered his address. The principal topic discussed by Mr. Almirall was the attitude of the Government in dealing with the general contractor in its vast building programme as well as undertaking the role of contractor itself.

GOVERNMENT ACTING AS CONTRACTOR FOR BUILDING WORK.

"Recently," he stated, "some of the Government's departments have adopted a practice which, if continued, may have the most serious consequences to our trade. Not only have these departments demanded that the general contractor shall, himself, construct all branches of the work, but in several cases the Government has actually hired labor direct, employed a mechanical superintendent, and executed these contracts, thus depriving us, not only of our means of existence, but has endangered our entire organization. Such action is not defensible from either a practical or economic standpoint.

"Existing organizations, with their knowledge of the details of the business and with highly trained men in their employ, are undoubtedly in a position to design and construct such work in our trade as the Government requires, much more economically and perfectly, than a new organization just brought together.

"The knowledge that the Government is about to launch another large construction program, has made the situation so critical that the association has presented the whole subject to the Chamber of Commerce of the United States, of which it is a member.

"In a further effort to prove that a continuance of such a policy would threaten ruin to a trade representing an investment of many millions of dollars, Messrs. Rutzler and Almirall and Secretary Gombers appeared on May 10 by appointment before the board of directors of the Chamber of Commerce in Washington and submitted a brief which stated our case in detail, and asked their assistance in presenting this matter before the proper Government department heads in Washington.

"This matter is of such paramount importance that it is more than probable additional steps will have to be taken not only by our trade, but by the entire building industry in order to convince the proper authorities of the wisdom and advisability of availing themselves of the ability, talent, and assistance of existing organizations and of the great harm which would assuredly follow their neglect."

STATUS OF THE HEATING INDUSTRY IN WAR TIMES.

Speaking of the heating contracting

business generally, President Almirall said:

"We submitted uncomplainingly to the restrictions and regulations of the Government experts, even when we felt at times they were in the nature of an experiment. We have also been willing and eager to give these experts the benefit of our experience and advice, and when our leading men were asked to leave their businesses and devote themselves entirely to Government work, they did so with the greatest cheerfulness and promptitude.

"We have only begun, however, and greater results have yet to be accomplished, for we fully understand that all business now is Government business. In the stress and strain of the effort to win the war, however, caution should be observed by the administration in regarding certain forms of industry as non-essentials and in putting too great restrictions upon them so that they become discouraged and cease to manufacture. For the war will end some day and industrial enterprise will again become normal. When it does, these concerns will be needed, and if, in the interval, they have been forced out of business, it will be a difficult matter to resume without very great loss. Rather than force such a situation as this it would be well to try to utilize their plants for Government work or guarantee to them a minimum return on their capital. The laws of the different States all led them to capitalize, build, and manufacture; guaranteed them protection as long as they obeyed the law and so in all fairness the Government should not summarily suppress them.

"This is peculiarly true in our own particular trade where the largely increased cost of all material, the difficulty of transportation, the scarcity of labor, and the lack of money for fixed investments has brought nearly all private and municipal work to a complete standstill.

"This means that the private residences and the mercantile buildings, the construction of which is the 'bread and butter' of our business, has been practically abandoned and been replaced by Government war work, mainly in factories, warehouses, and housing schemes. The great difficulty is that the Government has assigned its work to restricted areas, thus giving opportunities for construction work to relatively smaller numbers of our members. This condition is a difficult one for our trade to meet and it is unfortunate that the Government although without wilful intent, is increasing rather than lessening our problems.

"A formal communication addressed to the chairman of the Committee on Emergency Construction, which was then acting in an advisory capacity to the War Department in connection with the construction of new army cantonments, was presented by a special committee from your board of directors, consisting of Messrs. Danforth, Oakes, and Almirall, who went to Washington in June, 1917, offering the services of our national association and forcefully urging upon them the desirability of segregating the contracts for the mechanical equipment and awarding them directly by the proper departments.

"Our communication was not acted upon, although the heating appartus for a number of the national war and navy cantonments and other war construction has since been furnished and erected by members of our national association, as sub-contractors to a general contractor, and many on a cost plus percentage basis."

President Almirall spoke feelingly of the deaths of Alfred E. Kenrick, Paul H. Kendricken, John T. Sadler and George H. Zellers, all of whom had died since the previous convention in 1916. Still another figure prominently identified with the association, although not directly connected with it, was the late Alfred B. Jenkins, whom President Almirall described as one of the association's most loyal supporters.

The return of the Chicago local association to membership in the national association was announced, President Almirall calling attention to the fact that the Chicago association was the nucleus of the national organization in 1889 and that it was in Chicago that the convention first met. Eleven years later the Chicago local association left the national body, so that its readmission to membership at this time marks an important turning point in the history of the association.

Finally, President Almirall referred to the many members of the association who are on war service. "We reverently ask Gods' loving protection for them," he said, "but if it becomes necessary at the next convention to read the names of any as having made the supreme sacrifice, we may rest assured that they will have died bravely, facing the foe in the cause of freedom, democracy and righteousness."

Special attention was called by the president to the proposed "Standardized Accounting System," that was submitted to the convention at a later session by the Committee on Standardization.

As a step towards closer co-operation in the trade and a restriction of the evils of competition, Mr. Almirall proposed the adoption of what is known as "open-price" trade agreements, whereby the bids of members, after being submitted to the owner, general contractor, or architect, as the case may be, become known to every competing member. Many such associations are in existence today, he stated, in the building trade and their members are reaping large financial benefits.

OTHER SPEAKERS

Harry A. Wheeler, president of the United States Chamber of Commerce, who was on the programme for an address on "Organization of Industry for War," could not be present owing to illness, but the address was delivered very convincingly by his assistant, John N. De Vries, general secretary of the chamber. Mr. De Vries gave an account of the valuable work being done by the United States Chamber of Commerce and presented to the convention many facts and figures bearing on the accomplished results of the war service committees. He laid particular stress on the possibilities of conserving the nation's resources by a study of the needs of the various industries. He outlined the great value of elimination in many fields by standardizing methods of manufacture, applying the principles to shapes, sizes and colors of manufactured products.

C. V. Kellogg, president of the Kellogg-Mackay Co., then addressed the convention on the vital necessity of devoting all our energies to the winning of the war and safeguarding every present and future activity of the nation. He gave an outline of the work of the Trade Extension Committee for "Building Bigger Business" through new equipment in old buildings, and urged the members of the convention to further the campaign.

Louis Bruch, vice-president of the American Radiator Company, also addressed the convention on the Trade Extension Committee's campaign and gave details of the methods being used to further its work, explaining how the individual contractor may participate in the movement.

COMMITTEE APPOINTMENTS

At the opening of the afternoon session the following committee appointments were announced:

CREDENTIAL—J. Henry Howe, New York; F. E. Wheeler, Maine; F. S. Spencer, Minnesota; Fred W. Kaufman, Wisconsin; G. F. Ahrens, Iowa.

APPEALS AND GRIEVANCES—Harry G. Black, Pennsylvania; B. MacKenzie, North Carolina; A. Kilander, Illinois.

RESOLUTIONS—J. J. Herlihy, Illinois; Huga Urbauer, Missouri; John A. Creelman, New York; J. J. Collins, Missouri.

NOMINATING—Joseph G. Geoghegan, New York; Frank H. Meadows, Wisconsin; Robert S. Parks, Massachusetts; J. F. Gunn, Missouri; W. B. Van Sickle, Ohio.

AUDITING—S. A. Jellett, Pennsylvania; F. W. Howard, Massachusetts; William H. Curtin, New York.

CONSTITUTION AND RULES FOR CONVENTION PROCEDURE—J. E. Rutzler, New York; William H. Oakes, Massachusetts; George L. Bradbury, Colorado; N. F. Hughes Pennsylvania.

ASSOCIATION IMPROVEMENT—E. T. Child, New York; H. A. Snow, Massachusetts; E. J. Claffey, Illinois.

DISTRIBUTION OF REPORTS—S. A. Jellett, Pennsylvania; J. T. Dyas, New York; E. P. Ambler, Missouri.

The convention then went into executive session, at which were presented reports of the board of directors, Treasurer J. E. Rutzler and Secretary Henry B. Gombers, as well as the reports of committees and State and local associations.

It was at this session that the proposal was made to change the name of the organization to the "Heating and Piping Contractors National Association." The proposal was adopted with enthusiasm and it was recommended that all State and local associations be urged to adopt the new title. It will go into effect at once with the national association.

War matters came to the front again with the introduction of Lieutenant R. A. Bowlby, of the Canadian forces, who spoke at the request of the United States Shipping Board. He urged the great necessity of every one's doing his utmost to help speed up the production of ships. The remainder of the afternoon session was given over to an illustrated talk on "Cost Accounting," which served to emphasize the president's appeal for a standardized accounting system throughout the heating trade.

NEW OFFICERS

The convention again went into executive session Wednesday morning. In the afternoon announcement was made of the election of the following officers:

President, Edmund Grassler, Milwaukee, Wis.

Vice-President, W. H. Oakes, Boston.

Treasurer, J. E. Rutzler, New York.

Board of Directors: Harry Black, Philadelphia; E. T. Child, New York; N. L. Danforth, Buffalo; G. N. Getschow, Chicago; Joseph F. Gunn, St. Louis; W. B. Van Sickle, Cleveland; Edmund Grassler, Milwaukee; W. H. Oakes, Boston; and J. E. Rutzler, New York. At a later meeting of the new board of directors, Henry B. Gombers was re-elected secretary.

Past President Elias D. Smith officiated at the installation ceremonies, as in former years, and the new officers were given a hearty welcome by the members.

Resolutions were adopted pledging the association anew to the support of the government and also in appreciation of the members and members of their families engaged in government service. Resolutions of thanks were also given to the trade press, to the various speakers at the convention and to the ladies present.

Secretary Gombers announced that a telegram had been sent to Mrs. John T. Sadler, extending the condolences of the members upon the death of Colonel Sadler who died at his home in Elmira, N. Y., May 14th. The good wishes of the convention were also telegraphed to Sergeant-At-Arms John C. F. Trachsel, for his complete and early recovery.

The speaker of the afternoon was Edgar A. Bancroft, general counsel of the International Harvester Company, whose subject was "Business in War Time." Mr. Bancroft asked that everything in our lives, business and social, be dedicated to the supreme task of stamping out the false doctrine of the Hun, who is attempting to ride over the world's conception of honor, decency and law. Mr. Bancroft was given an ovation on the completion of his address. The convention then adjourned.

Entertainment

The principal entertainment at the

convention was a supper and dance in the Crystal Room of the Hotel Sherman on Tuesday evening, June 4. Members and guests numbering over a hundred were present. The supper was accompanied by entertainment features and this was followed by dancing which continued until a late hour.

On Tuesday afternoon the ladies were entertained at the Majestic Theatre and on Wednesday were taken on a delightful ride by automobile through Chicago's parks.

Convention Notes.

Chicago was represented at the convention by practically all the principal contractors and manufacturers of heating apparatus located in that city as well by representatives of out-of-town firms.

The delegation from the East included J. A. Almirall, New York; J. E. Rutzler, New York; Wm. H. Oakes, Boston; N. P. Bishop, New Haven; W. L. Danforth, Buffalo; Harry G. Black, Philadelphia; E. T. Child, New York; J. G. Geoghegan, New York; Elias D. Smith, New York; Stewart A. Jellett, Philadelphia; John A. Creelman, Rochester; J. Brandeles, Utica; W. H. Curtin, Brooklyn; F. E. Wheeler, Portland, Me.; Robert B. Miller, New York; L. W. Butterfield, Orange, N. J.; E. C. Butterfield, Brooklyn; Wm. J. Olvany, New York; G. E. Tauberg, New York; Henry B. Gombers, New York; Arthur Ritter, New York; Homer Addams, New York; B. K. Strader, New York.

Among the others present were noticed: J. F. Bradley, St. Louis; E. Grassler, Milwaukee; F. H. Meadows, Milwaukee; P. F. Maginn and W. S. McGinness of Pittsburgh; J. H. Howe, Rochester, N. Y.; J. A. Ziesse, Grand Rapids, Mich.; George L. Bradbury, Denver; W. C. Weatherly, Grand Rapids, Mich.; Otto Biefeld, Watertown, Wis.; and Jesse Coogan, Salt Lake City.

Nearly 250 members and guests signed the convention register.

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Trade Extension Work the Keynote at Annual Convention of National Association of Master Plumbers.

An unusually large attendance marked the thirty-sixth annual convention of the National Association of Master Plumbers, which was held in St. Louis, June 4-6. Nearly 1000 persons participated in the parade to the convention hall. In his report President L. McNamara gave some interesting details of the development of the trade extension movement. This started with a series of resolutions which have now become the programme for the "Building Bigger Business" campaign. It was adopted at a joint meeting of the members of the Master Plumbers' Association and the Manufacturers' and Jobbers' Associations, held in Chicago, February 22. The principal recommendations were:

"Whereas: In these times of national stress, it is more necessary than ever that the various interests constituting our industry should co-operate closely—become partners, in word and fact. Be it therefore

"Recommended: That the trade, and jobbers and manufacturers in the heating and plumbing industries should unite in adopting and encouraging keen, timely and uniform plans and practices of conducting promotion and publicity campaigns, which shall teach the public conservation, sanitation and wise investment, by means of the workmanship and materials which we collectively offer. Be it further

"Recommended: That members of the trade, jobbers and manufacturers should each carefully study his or their present advertising so that instead of the commonplace advertisements, which read like business cards, there may be substituted illustrations and text which shall give the public the most forceful, modern business messages of the conservation, sanitation, and prudent investment. The heating and the plumbing industries are so essential to comfort, health protection, domestic labor-saving, and large and enduring ecomony, that it is our patriotic and business duty to let the people know these facts, through especially prepared, electrotyped advertisements, show-window trimmings, window transparents, movie slides, street-car cards, bill-boards, circular letters, exhibits at annual national conventions, and other aids.

"Recommended: That where jobbers or manufacturers maintain public display rooms, and submit estimates of retail prices on their fixtures, and make no sales except through the trade that all such estimates, in order not to be misleading to the consumer, should carry a reasonable differential to the trade over and above the cost of doing business. And such estimates should be upon fixtures and appliances only, and in no case cover any part of estimating the cost by the trade, of the plumbing, roughing-in material, or labor of installation. And be it further

"Recommended: Where there is more than one member of the trade in a town, honest effort should be made by the jobbers or manufacturers to learn from the consumer the name of the member or members of the trade who may have previously done his or her work; and by first referring such inquiries, arising from advertising by the manufacturers or jobbers, to the member or members of the trade so named or nominated by the consumer, facilitate such prospective business; and inquiries arising from circularizing, the lists to be furnished by the trade, should be directly and solely referred to the member of the trade furnishing the list of such prospect or customer. And be it further

"Recommended: That the trade should co-operate in the publicity campaigns conducted in their respective localities by jobbers and manufacturers through endeavoring to canvass names of all farm and city building-owners whom the trade believe are fair prospects for the sale of modern forms of heating, plumbing, water supply, and vacuum cleaning devices. Such canvass of names to be made through calls from door to door, or by canvassing over the telephone, or by drawing off names from ledger, or from job ticket reports, etc., etc.

"Copy of such list of building-owner names to be sent only to a single jobber or manufacturer for circularizing—to save waste and duplication of advertising and postage, and also to avoid annoying property-owner with excess mail on the same general subject.

"All lists sent in to be marked specifically as to kind of article or merchandise, for which it is believed sale can be influenced or made.

"In furnishing names of prospective consumers the trade should carefully give correctly the names, initials, street and number (or rural route number) town, county and state.

"Resolved: That the manufacturers and jobbers in all of their future publicity cease referring to the heating contractor as a fitter and to the plumbing contractor as a plumber, and in all future publicity so word such publicity as to elevate the position of the plumbing and heating contractor."

The question of having a "business doctor" was given special attention at one of the Trade Extension Committee meetings, and as a result William J. Woolley, of Evansville, Ind., was engaged to make studies of the subjects of estimating, costs, installations, credits, accounting, sales, display rooms, advertising and other promotions.

The campaign for "Building Bigger Business," now being conducted in the trade press, is being handled through Mr. Woolley.

A contest arose over the presidency of the association for the ensuing year, the nominees being President McNamara and Vice-President Frank B. Lasette. The results of the ballots showed Mr. McNamara to have 160 votes and Mr. Lasette, 125. Mr. Lasette was later re-elected vice-president.

A remarkable display of plumbing goods and specialties occupied two floors of the convention hall.

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Current Heating and Ventilating Literature.

Under this heading is published each month an index to the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the article mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

HEATING DWELLINGS

How 20 Per Cent. of the Cost of Heating Buildings Can Be Saved. 800 w. Eng & Con—March 27, 1918. Suggestions sent by the Colo. State Council of Defense to householders for the proper use of coal. 20c.

ISOLATED PLANTS

Isolated Plant for Chemical Factory. Ills. 1500 w. Pwr Pt Eng—April 15, 1918. Steel encased boilers, underfeed stokers and four-valve engines make for efficiency. 20c.

Piping for Steam-Generating Plants.

PIPING

2500 w. Pwr Pt Eng—April 15, 1918. Installation and operation from safety viewpoint. 20c.

STEAM MAINS

Underground Steam Mains. Charles L. Hubbard, Ills. 2200 w. Power—April 2, 1918. Serial. 1st part. Need of care in construction as they are less accessible. 20c.

The Progress of Gas House-Heating.

A committee of the American Gas Institute has recently completed its report for 1917 on the progress made in the design of gas heating appliances and methods of installation in residences. The report is devoted mostly to illustrations and descriptions of representative house-heating appliances now in use, especially the larger types. Natural gas appliances are included, as well as those designed for burning manufactured gas. This was done because in many cases the manufactured-gas appliances are simply modifications of those designed for natural gas.

It is to be noted in the report that few gas appliances have been exhibited in combination with coal heaters. Practically all of the straight gas appliances, however, are adapted to auxiliary heating.

Regarding the use of coal furnaces equipped with gas burners that are a permanent part of the heater and are placed in the coal fire-box, permitting the furnace to be used with either coal or gas, as may be desired, the committee states that while reports on some coal-fired furnaces of this type seem to indicate that satisfactory results are being obtained, the committee, nevertheless, is of the opinion that, as a class, these appliances do not work out successfully when using gas, because of the somewhat lessened efficiency due to the clogging of the burners by coal-dust, ashes, etc., and the partial burning out of the burners from the heat of the coal fire.

The appliances are classified as central units and as individual room heaters. Separate sections are devoted to thermostatic controls and to formulas in use for determining radiation and gas consumption required for heating buildings.

Two radiation formulas are given, the first being as follows:

$$\frac{72\,G + 22\,W + 1\tfrac{1}{2}\,A}{240} = \text{Steam radiation in square feet.}$$

$$\frac{72\,G + 22\,W + 1\tfrac{1}{2}\,A}{150} = \text{Water radiation in square feet.}$$

where G = exposed glass in square feet.
W = exposed wall in squaare feet.
A = volume of air to be heated.

The second formula applies to ordinary residences and is simplified, "because residences are quite similar in general construction and use." This formula gives the number of B. T. U. required to maintain a constant temperature of 70° F. when the outside temperature is 0° F.:

(a) Square feet of window and outside doors multiplied by 72.

plus (b) Square feet of outside walls multiplied by 22.

plus (c) Contents in cubic feet multiplied by 1.4 equals (d) Number of B. T. U.

Note. Exposure factors. Windows and door surface (a) and wall surface (b) should be increased as follows:

North exposure, add 32%.

East exposure, add 12%.

West exposure, add 20%.

For each degree difference more or less than 70°, add or substract the proportionate number of B. T. U. required for 70° difference.

COMPUTATION OF GAS CONSUMPTION.

Having determined the heat loss in B. T. U. by means of the formulas, the consumption must be increased in pro- required to maintain the desired temperature is found by dividing the heat loss in B. T. U. by the thermal value of the gas in B. T. U. In an example, the thermal value of the gas is given as 550 B. T. U. per cubic foot. This consumption holds for a gas appliance operating at 100% efficiency. For any other efficiency the consumption of gas in cubic feet per hour portion.

In the section devoted to straight (central unit) gas appliances 13 types hot are shown for use with hot-air heaters, seven for steam heaters and eight for hot water. Combination coal and gas appliances include five makes for hot air and two for hot water. One interchangeable coal and gas appliance is shown and two for hot water and steam. The burners for converting coal heaters to gas number six types. Special attention is called to the desirability of making use of firebrick, suitably disposed around and above the burners, to obtain the best results.

Deaths.

Edward Clarence Meier, president of the Heine Safety Boiler Co., St. Louis, Mo., died suddenly while in attendance at a meeting of the District Production Division of the Emergency Fleet Corporation in Philadelphia, May 7. He had just completed a short address giving some of his views regarding the speeding up on the construction of boilers. Mr. Meier had worked in all departments of the company and was an expert on boiler construction.

CORRESPONDENCE

Duration in Hours of Varying Outdoor Temperatures.

Editor Heating and Ventilating Magazine:

In making calculations of steam and fuel consumption in heating plans, the number of hours in each 10° temperature during the heating season is needed and in order to obtain this information I wrote to the Weather Bureau at Washington, D. C. as follows:

"In making certain heating calculations particularly for the latitude of Boston or New York, but frequently for other parts of the country, I am desirous of obtaining United States weather reports or other publications that will give me the number of hours in the heating season for a given temperature.

"For instance, assuming the heating season to begin with September 15 and ending with May 15, I wish to ascertain if possible, the number of hours within that season within the following range:

From —20° to —10° F.
From —10° to 0° F.
From 0° to 10° F.
From 10° to 20° F. and so on
up to 70° as a maximum

"I frequently see references to weather reports which would indicate that such information is available. If so, can you supply me with the data?"

In reply the Weather Bureau states that this information is available if one wishes to pay the bureau for taking off for a given number of years in order to obtain an average. This, of course, is rather expensive, but as I frequently see computations of heating requirements made up in that way, I assume that some one has already had this work done.

Can you inform me from your acquaintance with either the technical schools, or any other authorities, where I can obtain this information in the form desired?

Boston, Mass. A. S. K.

It is questionable if such information is very valuable for the purpose to which our correspondent intends to apply it. While there may be a few buildings which are held strictly up to proper temperature during both day and night for seven days a week during the entire heating season, this is not common or even frequent practice. Most buildings have the heat off from 10 or 11 o'clock at night until 5 or 6 o'clock the following morning—such as institutions, hotels, etc., when the structures are occupied 24 hours per day. For office buildings, manufacturing and business blocks, the heat is seldom kept up after 6:00 P. M. or on Sundays; for schools, colleges, and other places of instruction, etc., heat may be shut off even earlier and on both Saturdays and Sundays.

Neither would it be fair to reduce the outside temperature hours in proportion to the number of hours heat is kept on for the time when the heating system is not in operation is during the coldest hours—viz:—from late at night to early morning. Also when starting to warm up in the morning a much heavier load must be carried for a short time (in order to bring the building up to temperature) than the state of the outside temperature would indicate.

In the vicinity named by our correspondent we believe a much more practical figure—and probably a more accurate factor than can be obtained by the method proposed—is to allow 100 lbs. of coal per square foot of equivalent direct radiation per season.

In a recent publication, however, we note a discussion of another subject in which the number of heating hours per year is given and we quote these here.

Number of Hours.	Temperature, Deg. F.
308	0 to 10
817	10 to 20
1142	20 to 30
1120	30 to 40
912	40 to 50
746	50 to 60
787	60 to 70
Total 5832	

It must be remembered that every hour when it is 60° outside does not require artificial heat and a great many hours when it is between even 50° and 60° will occur during cool nights when the days are at a perfectly comfortable temperature.

Ordinarily the heating season in the latitude of New York is presumed to cover about 200 heating days and, if heat is kept on the building for an average of 18 hours per day—which is an unusually high average—the total heating hours per season would be 3600 against the 5832 hours called for in the above. We suppose the above table is accurate but cannot give its source beyond the statement that it is based on "records of the Weather Bureau" nor can we guarantee its accuracy.

Interpretation of "Adequate Ventilation."

EDITOR HEATING AND VENTILATING MAGAZINE:

I find on Page 39 of THE HEATING AND VENTILATING MAGAZINE for May a short article entitled, "New York Board of Health Interprets Adequate Ventilation." It is gratifying to note that the importance of establishing some definite standards is being recognized, but I feel that this interpretation is open to criticism in certain particulars:

1.—*Temperature*: A temperature range from 60 to 70° F. is proper provided the humidity is maintained at a desirable point. A temperature of 60° requires a humidity of about 77% for comfort, but a temperature of 70° with this same humidity is extremely uncomfortable. The point I wish to make is that the dry-bulb temperature is not a satisfactory standard in itself, as the air moisture content has a very important bearing on the question. A satisfactory wet-bulb standard can be determined but this is not true of the dry bulb.

2.—*Humidity*: I find the statement under "Humidity" that the relative humidity in occupied rooms should not exceed 70%. This is, of course, true but a fixed maximum cannot be set. A dry bulb of 70° and a relative humidity of 70% would comply with these requirements, but the condition would be extremely uncomfortable. I find further the statement that the wet bulb should not exceed 78°. This, in my opinion, is entirely too high and it is questionable if the wet bulb should ever be allowed to exceed 60°.

3.—*Carbon Dioxide*: This is a satisfactory standard and requires no comment.

4.—*Dust*: The maximum standard for dust particles is given as 1,000,000 per cubic foot, or, by weight, 4 milligrams per 100 cu. ft. I fail to understand how there can be a very close relation between the count of dust particles and the weight in a given volume of air, as the character of the dust varies so widely in different places. Furthermore, when we consider dust particles existing in sizes so small that they cannot be seen even with the highest-powered microscope in more or less uniform gradations up to a size that can be easily seen with the naked eye, I feel that it is essential that a standard be set limiting the range of particles under consideration. We count the dust particles visible with a magnification of 50 diameters and allow 5,000 per cubic foot as a maximum in a well-ventilated room.

5.—*Bacteria*: The number of bacteria obtained by test will depend on the method used for making the determination.

6.—*Odors*: While it is true that it is desirable to have rooms entirely free from objectionable odors, still, as a matter of fact, this is impossible to attain. I have never found even a well-ventilated school class room, for instance, entirely free from odors.

E. V. HILL,
Ventilating Inspector in Charge.
Chicago, June, 1918.

◆

Comparative Tests in New York School Buildings With Mechanical and Natural Ventilating Systems.

A criticism of the present ventilating system in use in the public schools as inferior to the old-fashioned method of opening a window is contained in a bulletin of the Health Department of New York, just issued, which refers to the air which school children now have to breathe as "canned."

The criticism is based on a study which was made in co-operation with the New York State Commission on Ventilation of seventy-six classrooms in thirteen different schools; 5553 children were in the groups studied. The tests were carried on for five months in half of the rooms the windows were kept closed and the patent ventilating system was depended upon. In the other half the ventilating system was shut off and windows were opened. The results are set forth as follows:

"In the closed window, mechanically ventilated type of classroom kept at a temperature of about 68° F., the rate of absences from respiratory diseases was 32% higher than in the open window, naturally ventilated type of classroom kept at the same temperature, and about 40% higher than in the open window, naturally ventilated type of classroom kept at a temperature of about 50° F. In other words, the children in classrooms with closed windows and ventilated by mechanical methods were more subject to respiratory diseases, severe enough to keep them from school attendance, than were children who were in classrooms kept at the same or lower temperature and ventilated wholly by open windows. In the closed window, mechanically ventilated type of classroom kept at a temperature of about 68° F. the rate of respiratory diseases occurring among pupils in attendance was

98% higher than in the open window, naturally ventilated type of classroom kept at the same temperature, and about 70% higher than in the open window, naturally ventilated type of classroom, kept at a temperature of about 50°. In other words, the children in classrooms with closed windows and ventilated by mechanical methods were more subject to respiratory diseases not sufficiently severe to keep them from school attendance than were children who were in classrooms kept at the same or lower temperature and ventilated wholly by open windows."

The War and the Heating Engineer

Suggestions for Selecting, Storing and Using Coal.

Suggestions intended for householders for selecting, storing and using coal in house-heating equipment have been prepared by Dr. William H. Reid, smoke inspector of Chicago. Among Dr. Reid's suggestions are the following:

Domestic consumers who burned hard coal last winter may, under the United States Fuel Administration's rules, order two-thirds as much of this as they used last year; the remainder must be made up of bituminous, or soft, coal from Illinois, Indiana and Kentucky mines.

SELECT SAME SIZES.

In buying soft coal the householder should select coal of the same size as the hard coal used, the size not to exceed 3-in. lumps.

Fire bituminous coal by placing the fresh charge on only one side of the grate, leaving part of the surface of the fuel bed uncovered; this reduces heat losses from incomplete combustion and makes cleaning of flues necessary less frequently.

In firing anthracite spread this coal completely over the bed of live fire underneath and disturb as little as possible.

To make up hard coal deficit it is advisable that at least 1½ tons of soft coal be substituted for one ton of hard coal.

It may be advisable to burn soft coal exclusively in mild weather so the hard coal may be saved for severe winter weather.

HOW TO MIX COAL.

It is recommended that wherever advisable coal be stored in separate piles and mixed as used.

The two fuels can be mixed before firing, or the soft coal can be thrown on the fire first and then covered with' hard coal. Both methods have been used successfully.

Mr. Reid emphasizes the importance of cleaning the boiler, ashpit, grates, tubes and all gas passages, including smoke pipe connection between the boiler and chimney, at the beginning of the heating season before a fire is started.

Housing Accommodations for War Workers.

One of the problems of war-time production is the stabilizing of labor supply in connection with the gigantic construction and industrial undertakings upon which the War Department has embarked. Many cities containing factories producing munitions are congested by war workers beyond the power of these cities to furnish community facilities for the newcomers.

The programme to be worked out by the War Department, through the Community Organization Branch, includes the formation of housing companies and of building and loan associations, the encouragement of home-building by individuals and the extension of water, sewer, gas and electric service to the new housing districts.

The Third Liberty Loan yielded $4,170,019,650, subscribed to by about 17,000,000 buyers, it has been officially announced by the Treasury Department.

Naval Aviation Open to the Trade.

Word has been received that the naval aviation section of the Naval Reserve

Force needs a great number of men immediately. Good ratings and good pay are possible for qualified men. The list of ratings and the necessary trades are as follows:

Machinists' Mates.—General machinists, automobile mechanics and assemblers, toolmakers, die-makers and similar mechanical trades.

Quartermasters.—Cutters and cloth fitters, upholsterers, canvas workers, painters, tent riggers.

Carpenters' Mates.—Woodworkers of all kinds.

Blacksmiths.—Toolsmiths, forge men, furnace men, etc.

Coppersmiths.—

Shipfitters and all kinds of sheet metal workers.

Applicants must be American citizens from 18 to 35 years of age. Draft registrants will be accepted upon presentation of a letter from their local boards.

Men of the foregoing trades will be sent to school for special training. Applicants may enroll at 51 Chambers Street, New York, or at any Naval Recruiting Station in the United States.

Establishment of "Return Load" Bureaus.

"Return Load" bureaus have been established in 32 cities, according to an announcement of the National Automobile Chamber of Commerce, to assist shippers who have difficulties and delays in shipping by rail because of freight and express embargoes and shortage of freight cars. A list of these bureaus is published by the chamber, at 7 East 42nd Street, New York. In addition to putting shippers in touch with truck operators who can render service in inter-city hauling, the bureaus will also list merchants and manufacturers who have goods to ship. Thus a merchant in New York City, wishing to ship a 5-ton load to Hartford, Philadelphia or any other city where there is a "return loads" bureau, will, upon calling up the Merchants' Association in New York (telephone, Barclay 7660) be given advance information of any truck coming from such city with a load and desiring a return load.

Chicago Engineering Societies Co-Operate in War Work.

A joint war committee has been formed by representatives of technical societies centered in Chicago, with the purpose of placing at the disposal of the Government and possibly other authorized agencies the combined strength and resources for war work, as the need may arise. Meetings are held at the Chicago Engineers' Club. Edgar S. Nethercut of the committee is also secretary of the Western Society of Engineers, at 1735 Monadnock Building. Among the organizations represented on the committee is the Illinois Chapter of the American Society of Heating and Ventilating Engineers.

Heating Men in Military Service.

B. E. La Follette, who has had charge of the engineering, sales and advertising departments for the Clarage Fan Co., Kalamazoo, Mich., has resigned to enter Government service. He will be located either in Philadelphia or Washington as an engineer with the Requirements Division of the United States Shipping Board.

First Lieut. Oliver E. Willis, of the Ordnance Reserve Corps, has been transferred from Camp Hancock, Ga., to Edgewood, Md. Arsenal and placed on duty with the guard company. For the past two months he has been stationed at Camp Hancock in command of Third Company, Sixth Battalion, First Regiment, in the training of ordnance recruits.

NATIONAL DISTRICT HEATING ASSOCIATION

Committee Meetings Held July 8-9, 1918, at Cedar Point, Ohio.

While there will be no regular convention of the National District Heating Association this year, arrangements have been made to hold meetings of the executive committee, together with the chairmen of the standing committees and as many of the members as possible, at the Breakers Hotel, Cedar Point, Ohio, July 8 and 9, to discuss various matters now affecting the heating companies and to receive the reports of the standing committees for the year.

◆

Relative Cost of Pipe Coils and Radiators.

Discussing further the relative cost of pipe coils and cast-iron radiator, a correspondent writes:

"There is considerable room for argument on this question just at present. This is due largely to the variable labor factor which enters into the making and hanging of the coils. That is to say, a contractor can make coils up in his shop during spare time, and at odd hours when time cannot be profitably employed elsewhere. Also a cheaper man can be utilized to make up coils in the shop than would be required to send out on a job to install work.

"Having been connected with several of the largest of the local heating contractors for over 20 years as their estimator I have developed a system of keeping a tally on the actual costs of various operations in heating work by means of which I have and can produce some remarkably accurate estimates. Having revised and refigured these factors to suit labor and material prices of to-day I am inclined to the opinion that pipe coils have the best of it when made economically and in reasonably large units. Pipe coils certainly are cheaper when compared to legless radiators which require wall supports, and with wall radiators if the difference in efficiency is allowed for.

"On the other hand if small units are in question, or if column radiators standing on the floor are the alternative, or if the coils are not made up in an economical manner, a contractor might easily have his costs run a little higher on coils."

◆

A Building Contractor's Satire on Architects' Specifications.

General: The plans and specifications are to be taken together. Anything shown in the plans and not mentioned in the specifications and anything mentioned in the specifications and not shown on the plans is to be considered as both shown and specified; and anything wanted by the architect or any of his friends, or anybody else, (except the contractor) shall be considered as shown and specified, implied and required, and shall be provided by the contractor without expense to anybody but himself. If he can do the work without expense to himself, the work shall be taken down and done over again, until the expense is satisfactory to the architect.

Architect: The term architect herein appearing shall be understood to mean the architect or any engineer that he foolishly but courteously employs to assist in making trouble for the contractor.

Plans: The plans are to be considered diagramatic, and are to be followed only where space conditions make it possible to avoid so doing. Co-incidence between the plans and executed work shall not be considered a claim for extra compensation. The architect is not required to recognize coincidence. Anything that is right on the plans is to be considered right; anything that is wrong on the plans shall be discovered by the contractor, and shall be made right without telling on the architect or on bills. Anything that is forgotten or missed out of the plans and specifications, but which is necessary and required for the comfort and convenience of the owner, shall be provided by the contractor, to the satisfaction of everybody (except the contractor) and in full accord with the evident intent and meaning of the specifications, without extra cost to anybody but the contractor.

Rules and Regulations: The work throughout shall comply with all rules, regulations, caprices and whims of all city, county, State, national and international departments, bureaus and officials having or not having jurisdiction.

Materials: All the materials shall be the best of their several kinds. The contractor is expected to know and provide the best, irrespective of what is specified in detail. The architect reserves the right to change his mind about what is best. Any changes necessary to make work and material fit the mind of the architect shall be made by the contractor without extra charge.

Permits: The contractor shall obtain and pay all fees, annual dues, assessments and subscriptions to masked balls, organizations and coat and hat checks.

Guarantee: The contractor shall guarantee and does guarantee that he will keep in complete working order, anything that the architect asks him to attend to, so long as there is more work in sight in the architect's office.

Arbiter: In case of any dispute arising as to the nature, character, or extent of work shown, specified or implied, the matter will be decided by referendum and recall, after which the decision shall be set aside and revised by the architect and designer-in-chief of the national government.

Payments: Payments, if any, shall be made on the architect's certificate. Architects' certificates shall not be considered negotiable, nor are they legal tender. When once issued, the architect assumes no responsibility for their future usefulness. Partial payments shall be made as the work progresses in the amount of 85 per cent. of the value of the work done, as judged by the architect. In no case shall the judgment of the architect cover more than enough to pay the wiremen and helpers every Saturday night. The material men must take the customary chances. The final payment, if any, shall be made when everybody is satisfied (but the contractor). Any evidence of satisfaction on the part of the contractor shall be considered a just cause for withholding final payment.

The contractor shall accept and hereby does accept the conditions hereinbefore appearing, for himself, his ancestors and progenitor, his family, heirs, executors, his ox, his assignee and the stranger within his gates.—*From the Architect and Engineer.*

◆

Unique Ventilating System for One-Story School Buildings.

A novel method of ventilating a one-story school building is being used by Mullard & Pollard, architects, of Fort Worth, Texas. It is a unit classroom system, the heating coils, fan and plenum chamber being located in each classroom, located in the "attic" of the cloakroom, which is divided horizontally so that the height of the ceiling for the wardrobe proper is 7 ft., the full story height being 13 ft. Louvres are placed above the cloakroom window, fronting the individual air intakes. The exhaust air passes through a register at the bottom of the cloakroom door and out through an exhaust flue at the end of the cloakroom.

One of the advantages mentioned for this arrangement is that the control is always in the hands of the teachers. It is stated that the operation of the fan is not noticeable.

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School House Ventilation Law in Texas.

A new State law on ventilation for school buildings has been added to the list by the legislature of Texas. The law is known as "the State Schoolhouse Building Law," and covers lighting, heating and ventilating, interior woodwork, building permit, and penalty. Under "Heating and Ventilating," the law reads:

Section 5. That all schoolhouses shall be provided with sufficient heating apparatus.

Section 6. That all stoves, radiators or other sources of direct heat located within the class rooms or study halls shall be so jacketed, ventilated or otherwise protected that the desks upon the side next to the stove, radiator or other source of heat shall not be more than 5° F., hotter than the desks upon the opposite of the room.

Section 7. That all stoves, radiators or other sources of direct or indirect heat supplying heat for a class room or study hall shall be equipped with an automatic temperature regulator that will regulate the temperature of said class room or study hall automatically to within 2° of any set standard.

Section 8. That every class room or study hall shall be provided with an efficient apparatus whereby in cold weather a supply of 30 cu. ft. per minute of fresh, warm air shall be supplied to each pupil in such manner as not to place any pupil in a disagreeable draft, and shall be provided with exhaust flue or flues, with inlets at or near the floor line, so arranged as to effectively carry out of the room the cold and impure air without placing any pupil in a disagreeable draft.

◆

Completes Twenty-Five Years of Service With "Metal Worker."

Few men in the heating and plumbing and sheet metal trades are more widely or better known than Frank K. Chew, editor of the *Metal Worker*, and dean of the trade journalists in these fields. Unusual interest, therefore, attaches to the twenty-fifth anniversary of his service with the *Metal Worker*, April 10, 1918, which was made the occasion of congratulations and a presentation on the part of his co-workers, headed by his former associate, W. W. Macon. The presentation took the form of an Auto Graflex camera, a peculiarly appropriate gift in view of Mr. Chew's well-known talents as a photographer.

Mr. Chew's business career has been devoted entirely to the trade represented by the *Metal Worker*. This period is perhaps best described by himself, in referring to his anniversary.

"I left school abruptly," he said, "because there was an opening in a shop that did furnace heating, tin roofing and plumbing, sold stoves and house-furnishing goods and agricultural implements, so that one day I might be working on any of the various branches of this industry.

"After six years, because of my familiarity with the line of stoves made by the firm of Cox, Whiteman & Cox, of Philadelphia, I was engaged to fill the vacancy at the bottom left by those who were promoted to take the places made by the death of two members of the old firm. For a number of years I was with the concern which became the Abram Cox Stove Company.

"After some experiences with another concern in the manufacture of gas-burning apparatus I engaged on April 10, 1893, with *Metal Worker*."

Mr. Chew's activities in promoting the interests of the trade, both through the columns of the *Metal Worker*, and through his personal efforts, are reflected in many achievements that have left their permanent impress on the industry. That these activities are still in full swing is shown by his close connection with such movements as the proposed standard code of the heating engineers for warm-air furnace heating, and similar movements.

His many friends, both in and out of the trade, will wish him many more years of health and service in his chosen field.

◆

New Publications.

FUEL ECONOMY IN THE OPERATION OF HAND-FIRED POWER PLANTS, containing suggestions to owners, managers, superintendents, engineers and firemen for effecting greater economy and in determining the properties and characteristics of the coal purchased, has been published by the Engineering Experiment Station of the University of Illinois.

It is a 90-page booklet, printed in four colors, and presents data to show that the average small power plant can save 15% of its fuel by the exercise of greater care in equipment and operation. This means a saving of twelve or thirteen million tons per annum if applied throughout the country.

Features of installation essential to the proper combustion of fuel are discussed, the practise to be observed in the operation of the plant is outlined; and the employment of simple devices for indicating conditions of operation is prescribed.

The scarcity of coal last winter and the recent warnings of the fuel administration regarding the possibility of a shortage next winter emphasize the need for greater economy in the use of fuel. The present high rate of production is still insufficient to supply all needs and there seems to be no possibility of an increase in the output of the mines sufficient to satisfy every demand.

There are two possible results of his fuel shortage; either certain industries must close down or more work must be done with the coal available.

A number of leading engineers acted as an advisory committee in the preparation of the publication which is listed as Circular No. 7. The edition is limited.

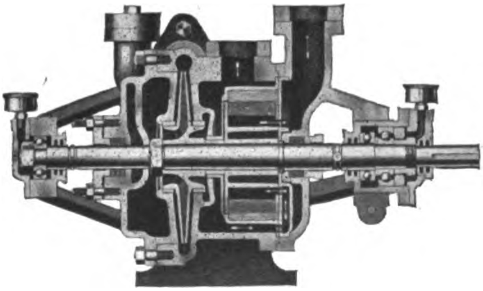
DIRECTORY OF THE AMERICAN ASSOCIATION OF ENGINEERS is the title of a unique publication containing a membership list of that organization arranged with the idea of assisting the employer of technical men to obtain the right engineer for his work. Such space as is permitted is given to the experience of each member. The information is also classified. It is the intention to place this directory with every large commercial association and business office in the country. Some 2500 members are listed. Size 6x9 in. (standard) pp. 250. Price, $2.00.

REPORT ON THE THERMAL TESTING PLANT FOR 1916-1917 being Bulletin No. 24 of the Engineering Experiment Station of the Pennsylvania State College, has been received. It is compiled under the authorship of R. B. Fehr. The present tests were undertaken primarily to ascertain where the greatest resistance was offered to the passage of heat through a comparatively good conductor such as glass. Another purpose was to establish a suitable location for inside and outside thermometers in the testing plant. It was learned from the tests that the glass itself offers but slight resistance to the flow of heat, but that the air layers within ½ in. of both surfaces are responsible for the greater part of the resistance. An outside air velocity of 1000 ft. per minute increases the transmission about 70%. Size 6 x 9 in. Pp. 24.

◆

Trade Literature.

JENNINGS TURBINE VACUUM AND LOW-PRESSURE BOILER-FEED PUMPS are brought to the attention of the trade in a well-compiled and carefully-illustrated circular published by the Nash Engineering Co., South Norwalk, Conn. These pumps are used for return-line heating systems, or other vacuum work where large percentages of liquids have to be handled with gas. The pump consists of two independent turbine units, an air pump and a water pump, combined in one casing, with the impeller



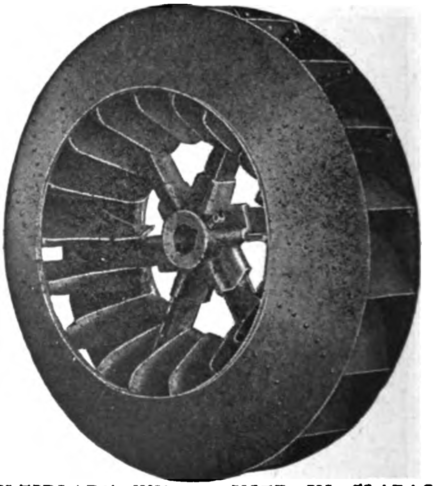
LONGITUDINAL SECTION SHOWING ARRANGEMENT OF AIR AND WATER PUMPS ON THE SAME SHAFT.

of each mounted on the same shaft. One unit continuously exhausts air and vapors from the heating system and the other removes the condensation as it accumulates and forces it directly into the boiler, or up to the hot well. Emphasis is laid on the fact that the boiler pressure is against the water only, the air and vapor being delivered to the atmosphere without back pressure. It is stated that the saving in horse-power amounts to over 50%. The air unit of the Jennings pump is the well-known Nash hydroturbine. All parts of the pump are illustrated in section and in operation. Data are included for determining required sizes. Size 8 x 11 in. Pp. 8.

F. & K. **Hot-Blast Radiators**, made by the F and K Products Co., Cleveland, O., are illustrated and described in a circular devoted to this product. This radiator is the invention of W. M. Kingsbury and M. L. Foote. It is of cast iron and is made in single sections, and assembled with slip nipples. Features of its construction include a divided steam chamber, and provision for air impingement, while attention is also called to the ease with which it may be assembled. The internal construction of each section is divided into three parts, a center chamber and two outer chambers. The center chamber receives the steam and is conveyed to the top of each section for distribution to the two outer chambers without coming into contact with the steam, water or air of the outer chambers. By this method of construction, a drop or minus pressure in the outer chambers is obtained, which causes a partial vacuum to be formed, thereby causing the air and steam to be drawn completely through the entire section and to be expelled through the return chamber. By this method no air binding can occur which makes every square foot prime and effective heating surface. The extended cored heating surface is set on an angle running horizontally and spaced equally in form so as to split the incoming air. The friction is divided by the projections being so formed that three rows are splitters and the two inner rows are circles designed to wrap the air which makes the impingement perfect and all sides effective. The resistance can be increased or decreased by varying the length of the slip nipple, giving any free area desired. The "F and K" hot-blast radiator is made in three heights, 40-in., 50-in., and 60-in., and 9 3/16-in. wide, with any spacing desired.

"F and K" HOT-BLAST RADIATOR.

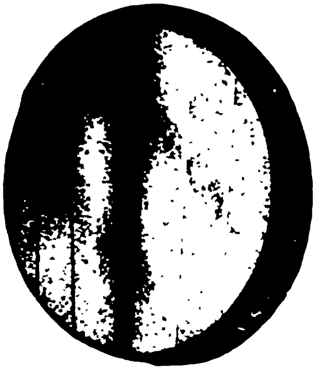
Clarage Style C Pressure Blowers are discussed in a new engineering catalogue issued by the Clarage Fan Co., Kalamazoo, Mich. (Catalogue No. 22.) These blowers may be classed as steel-plate fans, as they are built with housings or casings, of heavy sheet steel on an angle-iron frame. They are especially suited for operation at comparatively high speeds and against moderately high pressures. The multiblade wheel used with these fans, it is stated, is responsible for the high mechanical efficiency, besides making it possible to handle relatively large volumes and to maintain high pressures with a small size and low speed. The fans are intended principally for delivering moderate volumes against pressures of from 5 to 15 in. water gauge. The catalogue takes



MULTIBLADE WHEEL USED IN CLARAGE STYLE C "HIGH-EFFIENCY" BLOWERS.

up, with the usual thoroughness characteristic of this company in its published matter, the details of construction, together with a set of capacity tables covering the range of each size of fan. Size, 8½x11 in. (Standard). Pp. 16.

Autovent Modern Ventilating Apparatus is the subject of a new catalogue (fifth edition) published by the Batterman Truitt Co., Chicago, Ill. In addition to the company's line of Autovent motor-driven propeller fans, for use with both alternating and direct current, the catalogue describes the Autovent louvre, the construction of which is shown in the accompanying illustration. These louvres are round in design to correspond with the various sizes of fans. They are especially designed to prevent back draft and to provide weather protection to fan openings when the fan is not running. They consist of a number of semi-circular vanes connected together in series and pivoted slantingly, which drop into a closing position without exerting an excessive resistance against their opening movement caused by air directed against them from the opposite side. When the vanes are open or in a partly-open position, they assume an angle designed to afford a better passage of air from the fan than is obtained by the ordinary louvre. The vanes of the louvre are made of galvanized iron, while all working parts are made of brass. Installation dimensions are included, with the additional note, "all sizes carried in stock for quick shipment." Size of catalogue, 3½x6¼ in. Pp. 22.



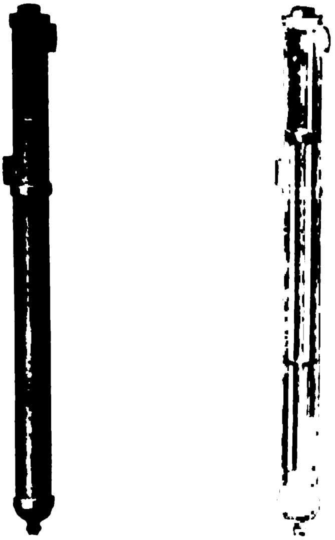
AUTOVENT LOUVRE CLOSED.

"Accepted and Approved" is the title of a circular giving the results of an efficiency test, made at Purdue University, Lafayette, Ind., of Clarage Kalamazoo vertical steam engines. The circular summarizes the test and the conclusion reached and note is made that the complete test is on file and will be shown to those interested. It was found, among other things, that the horsepower developed was large, the mechanical efficiency "very high," and the steam consumption below the average. Illustrated descriptive matter regarding this type of engine is included in the circular, including a cross-section view. The engines are stated to be especially suited for driving stokers or mechanical draft apparatus, small generators or centrifugal pumps, and fans or blowers.

◆

Hoffman Equalizing Loop.

A unique appliance, known as the Hoffman equalizing loop has been brought out by the Hoffman Specialty Co., Chicago, Ill. As will be seen from the accompanying illustration, the Hoffman equalizing loop is made entirely of metal, without moving parts or mechanical device of any kind. The upper part of the loop, shown in the accompanying sectional view, is made of special casting, having a diaphragm just above the lower side inlet which divides the loop into upper and lower chambers. The upper and lower openings of the loop are tapped for 1¼-in. pipe. The upper and lower chambers are connected by means of two brass pipes screwed into the diaphragm. One of these pipes extends above the diaphragm, the other being flush with the diaphragm. The lower end of one of the pipes is slotted vertically, as shown in the illustration.



Exterior View. Phantom View.

HOFFMAN EQUALIZING LOOP.

The steam supply connection from the

top of the boiler or from the supply main is connected into the lower opening of the casting and the operation of the loop is peculiar, in that it is entirely neutral, performing no function except that of freely passing such condensation as may come to it, so long as the boiler pressure is 10 oz. or less. Should, however, the boiler pressure exceed 10 oz. the water is pushed down in the loop until the slotted pipe is uncovered, when steam immediately passes through the slot into the return line, thus tending to balance the pressure between the two lines.

The function of the slotted pipe is to pass just sufficient steam into the return line to maintain the pressure in the supply line 10 oz. greater than in the return line, when the pressure on the boiler is over 10 oz.

So long as the boiler pressure is above 10 oz. the differential between the supply and return line is exactly 10 oz., no matter whether the pressure is 10 oz. or 5 lbs., and this 10 oz. differential causes the water to stand in the vertical return pipe just 17 in. higher than the water line in the boiler, and the water loss from the boiler is measured by the quantity contained in the vertical pipe to a height of 17 in.

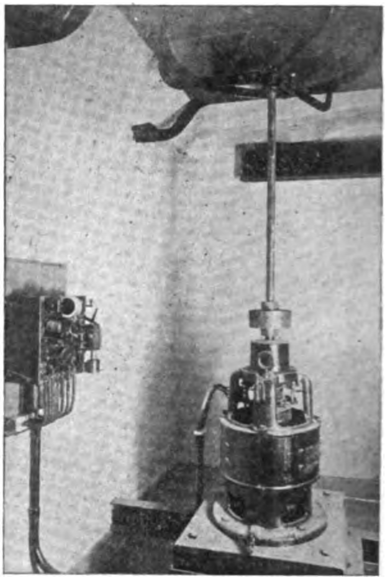
Therefore this device, it is stated, will maintain an unvarying water line in the boiler, independent of boiler pressure, and hence the water line in the boiler is never lowered to a point where the heat from the fire can exert an influence that is destructive to the castings which compose it.

◆

Ventilating Equipment of a Fifth Avenue Residence, New York.

One of the well-known landmarks of New York is a large brown-stone residence on the corner of Fifth Avenue and 51st Street. This dwelling was built many years ago before modern conveniences were known and though from time to time improvements have been added, it has heretofore lacked a system of mechanical ventilation. This defect has now been remedied, however, and a complete system has been put in.

In all, three motor-driven ventilating fans have been installed, for the kitchen, ball room and picture gallery, and the toilets, respectively. These sets are installed in the upper floors in small rooms where they are out of sight but readily inspected when necessary. Quiet operation is essential for installation of this kind and the equipment was selected with this feature in mind. All three fans are started and stopped by push buttons placed in or near the rooms served so that the ventilation can be readily controlled at the point where the air is needed. The speed of the motors is regulated by means of manually-operated field-and-armature control rheostats.



ARRANGEMENT OF TOILET EXHAUST OUTFIT IN FIFTH AVENUE RESIDENCE.

The toilet exhaust outfit is somewhat unusual. It consists of a vertical 2 H. P. Westinghouse direct-current motor, 333/500 R.P.M. coupled to a 36-inch Blackman fan. The motor rests on a cast-iron base which is carried by I-beams set in the wall. The air is carried by ducts which terminate in the closet containing the motor and is then exhausted into the open air.

The ball room and picture gallery set consists of the same type and size of motor and fan, but the fan is mounted horizontally and carries the motor directly on its shaft.

The kitchen exhaust set consists of a 2 H.P. Westinghouse direct-current motor, 266/400 R.P.M.; and a No. 4 Sirocco blower.

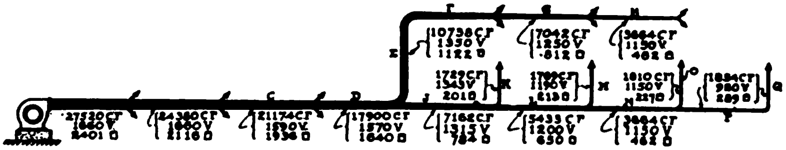
Baker Smith & Co., New York, were the ventilating engineers.

◆

John A. Stevens Trust Fund has been established by The American Society of Mechanical Engineers, through the generosity of John A. Stevens, to promote progress in the art of engineering. The fund consists of a $15,000 insurance policy which will eventually be turned over to the society. The net annual income accruing from this fund will then be allotted annually in equal shares to the person or persons who have that year invented or been responsible for an invention having to do with the conservation of light, heat and power.

SIZING OF DUCTS AND FLUES. METHOD NO. 5.

NOTE.—For explanation and example assumed see Standard Data Sheets Nos. 10-M and 10-N.



SIZES BY METHOD NO 5

A method used by another prominent engineer provides for temperature drop in the duct and then utilizes the equivalent number of 1-in. pipes in determining the duct areas. The amount of temperature drop is variable, depending upon the material used for the construction of the duct, its location, and its insulation. It is a very simple proposition to test the temperature drop for any length of run in an installation already working and to thus develop the number of feet of run for 1° drop in temperature. For convenience in calculating, it has been assumed in the following that there is 1° drop in every 20 ft. of run and the temperature at the fan is assumed as 120° F.; thus, the air 20 ft. from fan would be 119° F., at 40 ft., 118°, etc.

The formula to obtain the quantity of air for any given B. T. U. loss per hour is:

$$\text{Cubic feet per minute equals } \frac{\text{B. T. U.}}{60\ (T\text{-}t)\ DS}$$

When B. T. U. = heat required in B. T. U. per hour.
T = temperature F. of entering air.
t = temperature F. of room air.
D = density of entering air at temperature T.
S = specific heat of air.
60 = number of minutes in an hour.

If the heat loss in each room is exactly equal to the heat brought in by the 1500 cu. ft. of air at 120° F. and 70° F. is the room temperature, the heating requirement is

$$\frac{1500 \times (120 - 70) \times 60}{60} \text{ or } \frac{1500 \times 50 \times 60}{60} = \frac{4500000}{60} = 75000 \text{ B.T.U.}$$

50 being the number of cubic feet 1 B. T.U. will raise 1° at 120° (temperature T).

Then by substituting, the C.F.M. (for any outlet where the B.T.U. loss is 75000 B. T. U.) will equal:

$$\frac{75000}{60 \times (T\text{-}t) \times 0.0685 \times 0.2375}$$

At 1° drop in temperature every 20 ft. the temperature at the outlets at the end of duct will be

A = 119°
B = 118°
C = 117°
F = 114°
G = 113°
H = 112°
K = 114½°
M = 113½°
O = 112½°
Q = 111½°

$$A = \frac{75000}{60 \times (119\text{-}70) \times 0.0685 \times 0.2375}$$

(Continued on Sheet No. 10-S)

METHOD NO. 5—Continued.

(Concluded from Sheet No. 10-R)

The fall in temperature is so slight in any one system that to save computation.

$$\frac{75000}{60 \times 0.0685 \times 0.2375}$$

may be reduced to a constant, which divided by (T-t) will equal C. F. M. This reduces to

$$\frac{75000}{0.976125} \text{ or } 76940$$

Then

$$A = \frac{76940}{119-70} \times 2, \text{ or } \frac{76940}{49} \times 2, \text{ or } 1570 \times 2 = 3140$$

$$B = \frac{76940}{118-70} \times 2, \text{ or } 1603 \times 2 = 3206$$

$$C = \frac{76940}{117-70} \times 2, \text{ or } 1637 \times 2 = 3274$$

$$F = \frac{76940}{114-70} \times 2, \text{ or } 1748 \times 2 = 3496$$

$$G = \frac{76940}{113-70} \times 2, \text{ or } 1789 \times 2 = 4578$$

Then

$$H = \frac{76940}{112-70} \times 2, \text{ or } 1832 \times 2 = 3664$$

$$K = \frac{76940}{114\frac{1}{2}-70} = 1729$$

$$M = \frac{76940}{113\frac{1}{2}-70} = 1769$$

$$O = \frac{76940}{112\frac{1}{2}-70} = 1810$$

$$Q = \frac{76940}{111\frac{1}{2}-70} = 1854$$

The total air to be delivered by the fan is the sum of these totals, or

A 3,140, B 3,206, C 3,274, F 3,496, G 3,578, H 3,664, K 1,729, M 1,769, O 1,810, Q 1,854. Total 27,520 C. F. M.

The same steel plate fan previously considered will deliver the required amount of air and, as previously noted, its outlet is 42 in. x 42 in. or equivalent to 11,432 1-in. pipes. Then the

$$\frac{11432}{27520} = 0.415$$

Say 0.42, the number of 1-in. square pipes to be allowed to each cubic foot of air per minute, this being called the factor (F). This factor, however, is usually made from 0.6 for shorter systems to 0.7 for longer systems to avoid excessive friction losses and high velocities. If 0.6 is used:

C.M.F.		F.		1-in. Sq. Pipes
3140	x	0.6	=	1884
3206	x	0.6	=	1924
3274	x	0.6	=	1964
3496	x	0.6	=	2098
3578	x	0.6	=	2147
3664	x	0.6	=	2198
1729	x	0.6	=	1037
1769	x	0.6	=	1061
1810	x	0.6	=	1086
1854	x	0.6	=	1112

Duct sizes with allowance for temperature drop, Method No. 5.

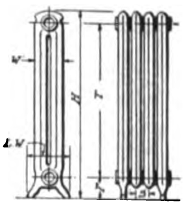
H = 2198, or 21 in. x 22 in. = 462 sq. in. of duct.
G = 2198 + 2147 = 4345, or 28 in. x 29 in. = 812 sq. in. of duct.
E and F = 4345 + 2098 = 6443, or 33 in. x 34 in. = 1122 sq. in. of duct.
P and Q = 1112, or 17 in. x 17 in. = 289 sq. in. of duct.
O and N = 1112 + 1086 = 2198, or 21 in. x 22 in. = 462 sq. in. of duct.
M and L = 2198 + 1061 = 3259, or 25 in. x 26 in. = 650 sq. in. of duct.
K and J = 3259 + 1037 = 4296, or 28 in. x 28 in. = 784 sq. in. of duct.
E and J = 4296 + 6443 = 10739, or 40 in. x 41 in. = 1640 sq. in. of duct.
C = 10739 + 1964 = 12703, or 44 in. x 44 in. = 1936 sq. in. of duct.
B = 12703 + 1924 = 14627, or 46 in. x 46 in. = 2116 sq. in. of duct.
A = 14627 + 1884 = 16511, or 49 in. x 49 in. = 2401 sq. in. of duct.

It can readily be seen that the proper quantity of air will be delivered to maintain the heat equilibrium and that the duct friction is kept at a fairly constant point, although not quite constant, as no allowance is made for bends, transformations, etc., and while the duct sizes thus obtained increase toward the far end of the system it is only because they are expected to handle a greater quantity of air at the same friction loss per foot of duct in order to compensate for temperature drop in the duct.

DUCTS AND FLUES—SIZING—FIFTH METHOD (Cont'd) **No. 10-S.**

H. B. SMITH CO.'S PRINCESS TWO-COLUMN RADIATORS FOR STEAM AND WATER.

Sections	Total Length	HEIGHT, INCHES					
		45	37	31	25	22	19
	ft - in.	5 ft. per sec.	4 ft. per sec.	3½ ft. per sec.	3 ft. per sec	2⅝ ft. per sec	2¼ ft. per sec.
3	0 - 10	15	12	10½	9	7⅞	6¾
4	1 - 1	20	16	14	12	10½	9
5	1 - 4	25	20	17½	15	13⅛	11¼
6	1 - 7	30	24	21	18	15¾	13½
7	1 - 10	35	28	24½	21	18⅜	15¾
8	2 - 1	40	32	28	24	21	18
9	2 - 4	45	36	31½	27	23⅝	20¼
10	2 - 7	50	40	35	30	26¼	22½
11	2 - 10	55	44	38½	33	28⅞	24¾
12	3 - 1	60	48	42	36	31½	27
13	3 - 4	65	52	45½	39	34⅛	29¼
14	3 - 7	70	56	49	42	36¾	31½
15	3 - 10	75	60	52½	45	39⅜	33¾
16	4 - 1	80	64	56	48	42	36
17	4 - 4	85	68	59½	51	44⅝	38¼
18	4 - 7	90	72	63	54	47¼	40½
19	4 - 10	95	76	66½	57	49⅞	42¾
20	5 - 1	100	80	70	60	52½	45
21	5 - 4	105	84	73½	63	55⅛	47¼
22	5 - 7	110	88	77	66	57¾	49½
23	5 - 10	115	92	80½	69	60⅜	51¾
24	6 - 1	120	96	84	72	63	54
25	6 - 4	125	100	87½	75	65⅝	56¼
26	6 - 7	130	104	91	78	68¼	58½
27	6 - 10	135	108	94½	81	70⅞	60¾
28	7 - 1	140	112	98	84	73½	63
29	7 - 4	145	116	101½	87	76⅛	65¼
30	7 - 7	150	120	105	90	78¾	67½



DIMENSIONS

H = Total overall height.
T = C. to C. of tappings.
F = Floor to center of bottom tapping.
W = Width of radiator—5 1/4 in.
WL = Width of radiator legs—5 1/4 in.
S = Width of radiator sections—3 in.

Nominal Height of Radiator	45-in.	37-in.	31-in.	25-in.	22-in.	19 in.
H	45	37	31	25	22	19
T	38 3/8	30 3/8	24 3/8	18 3/8	15 3/8	12 3/8
F	4 5/8	4 5/8	4 5/8	4 5/8	4 5/8	4 5/8

Note: For legless radiators deduct 3 in. from H.
For extra high legs add 1 in., 2 in., 3 in., or 4 in. to H. and to F.
On all radiators extra high legs are special.

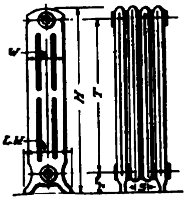
TAPPING DATA

SYSTEM	Size of Radiator Square Feet	Supply In. Diam.	Return In. Diam.
Steam, one-pipe	Up to 30	1	.....
	Over 30 up to 60	1 1/4	.....
	Over 60 up to 120	1 1/2	.....
	Over 120	2	.....
Steam, two-pipe	Up to 50	1	3/4
	Over 50 up to 120	1 1/4	1
	Over 120	1 1/2	1 1/4
Water	Up to 50	1	1
	Over 50 up to 120	1 1/4	1 1/4
	Over 120	1 1/2	1 1/2

All air valve tappings are 1/8 in., those for water radiators being set at top.
All tappings with R. H. threads, unless otherwise ordered.

H. B. SMITH CO.'S PRINCESS THREE-COLUMN RADIATORS FOR STEAM AND WATER.

Sections	Total Length	HEIGHT, INCHES					
		45	37	31	25	22	19
	ft. - in.	8 ft. per sec.	6½ ft. per sec.	5½ ft. per sec.	4½ ft. per sec.	4 ft. per sec.	3½ ft. per sec.
3	0 - 10¾	24	19½	16½	13½	12	10½
4	1 - 2	32	26	22	18	16	14
5	1 - 5¼	40	32½	27½	22½	20	17½
6	1 - 8½	48	39	33	27	24	21
7	1 - 11¾	56	45½	38½	31½	28	24½
8	2 - 3	64	52	44	36	32	28
9	2 - 6¼	72	58½	49½	40½	36	31½
10	2 - 9½	80	65	55	45	40	35
11	3 - ¾	88	71½	60½	49½	44	38½
12	3 - 4	96	78	66	54	48	42
13	3 - 7¼	104	84½	71½	58½	52	45½
14	3 - 10½	112	91	77	63	56	49
15	4 - 1¾	120	97½	82½	67½	60	52½
16	4 - 5	128	104	88	72	64	56
17	4 - 8¼	136	110½	93½	76½	68	59½
18	4 - 11½	144	117	99	81	72	63
19	5 - 2¾	152	123½	104½	85½	76	66½
20	5 - 6	160	130	110	90	80	70
21	5 - 9¼	168	136½	115½	94½	84	73½
22	6 - ½	176	143	121	99	88	77
23	6 - 3¾	184	149½	126½	103½	92	80½
24	6 - 7	192	156	132	108	96	84
25	6 - 10¼	200	162½	137½	112½	100	87½
26	7 - 1½	208	169	143	117	104	91
27	7 - 4¾	216	175½	148½	121½	108	94½
28	7 - 8	224	182	154	126	112	98
29	7 - 11¼	232	188½	159½	130½	116	101½
30	8 - 2½	240	195	165	135	120	105



DIMENSIONS

H = Total overall height.
T = C. to C. of tappings.
F = Floor to center of bottom tapping.
W = Width of radiator.
WL = Width of radiator legs.
S = Width of radiator section.

Nominal Height of Radiator	45-in,	37-in.	31-in.	25-in.	22-in.	19 in.
H	45	37	31	25	22	19
T	38 3/3	30 3/8	24 7/16	18 9/16	15 3/8	12 9/16
F	4 5/8	4 5/8	4 5/8	4 5/8	4 5/3	4 5/8

Note: For legless radiators deduct 3 in. from H.
For extra high legs add 1 in., 2 in., 3 in., or 4 in., to H. and F.
On all radiators extra high legs are special.

TAPPING DATA

SYSTEM	Size of Radiator Square Feet	Supply In. Diam.	Return In. Diam.
Steam, one-pipe	Up to 30	1	.....
	Over 30 up to 60	1 1/4	.....
	Over 60 up to 120	1 1/2	.....
	Over 120	2	.....
Steam, two-pipe	Up to 50	1	3/4
	Over 50 up to 120	1 1/4	1
	Over 120	1 1/2	1 1/4
Water	Up to 50	1	1
	Over 50 up to 120	1 1/4	1 1/4
	Over 120	1 1/2	1 1/2

All air valve tappings are 1/8 in., those for water radiators being set at top.
All tappings with R. H. threads unless otherwise ordered.

Hot Water Supply

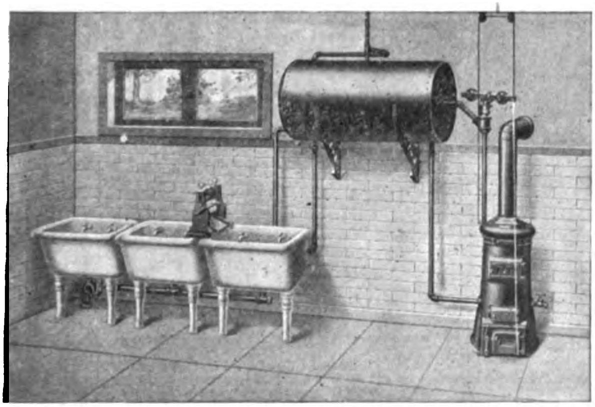
For Residences, Factories or Community Groups

The cheapest and most satisfactory method for supplying plenty of hot water for domestic and other purposes is by means of

IDEAL Hot Water Supply Boilers

Connected either to vertical or horizontal storage tanks. The water is heated rapidly and temperature may be automatically maintained and fire controlled by a Sylphon Water Regulator. This combination is remarkable for its economy, efficiency and ease of operation.

IDEAL Hot Water Supply Boiler and Kitchen Range Tank. Temperature of water always just right. Regulated automatically.



IDEAL Hot Water Supply Boiler connected to large horizontal tank. Sylphon Water Regulator gives uniform water temperature. Automatically controlled.

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Send for special booklet.

AMERICAN RADIATOR COMPANY

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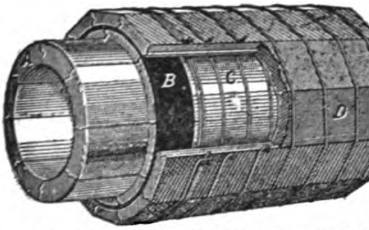

A—Inner Shell, 2 inches thick.
B—Asphaltum Packing.
C—Dead Air Space.
D—Outer Shell, 1 inch thick.

Cover Your Steam Pipes
WITH WYCKOFF'S IMPROVED
CYPRESS COVERING

Made of Gulf Cypress, the wood eternal

Not affected by wet and dry conditions common to steam-pipe trenches. Will not rot. Lasts twice as long as Pine Casing. Absolutely water and steam tight. Each shell is wound with heavy galvanized wire. Coated all over with the best known preservative—Hydrolene B.
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THE HEATING AND VENTILATING MAGAZINE

Cooperstown, N. Y. August, 1918 1123 Broadway, New York

A Study of Degrees of Discomfort

Based on Temperature Comfort Tests Made at the Chicago Normal College by Professor J. W. Shepherd.

During the intense hot spell last summer the *New York World* published the following inquiry on its editorial page:

"Showers that reduce the temperature and increase the humidity maintain the same average discomfort. Can not a method of registering heat and humidity be devised by which their combined devilishness can be indicated by one figure?"

This brings up an intricate subject, but one in which there is considerable popular interest; the average man does not know whether 88° and 40% humidity is more comfortable than 85° and 80% humidity, and indeed few engineers perfectly familiar with the relation between humidity and temperature would be able to answer this offhand. The word "humidity," of course, means moisture in the air and is usually expressed either as "absolute" humidity (the weight in grains of the water contained in 1 cu. ft. of air in the form of vapor) or as "relative" humidity (the percent of water contained in the air based on what the air could contain when saturated). "Relative" humidity is what is commonly meant when simply "humidity" is designated. How increased humidity makes us feel hot and uncomfortable is well known, but the exact relation can only be determined by the "feelings" of the average individual.

Nevertheless such a relation does exist and while its derivation is, perhaps, somewhat complex, the results can be tabulated into an easily comprehensible form. The entire relationship, depending on the average person's feelings, was tested and registered in a most thorough manner by Prof. J. W. Shepherd in the experimental room of the Chicago Normal College during 1912; these tests extended over a period of three months and involved many experiments on a large number of people. Dr. E. Vernon Hill, of the Chicago Department of Health, plotted the results on a chart and developed a formula which shows what humidity would be considered as ideally comfortable by the average person at any given temperature between 54° and 79° F. The formula deduced from the experiments is that

$$H = 100 - 4\ (T - 54) \text{ or}$$
$$H = 316 - 4\ T$$

When H = the relative humidity and
T = any temperature between 54 and 79° F.

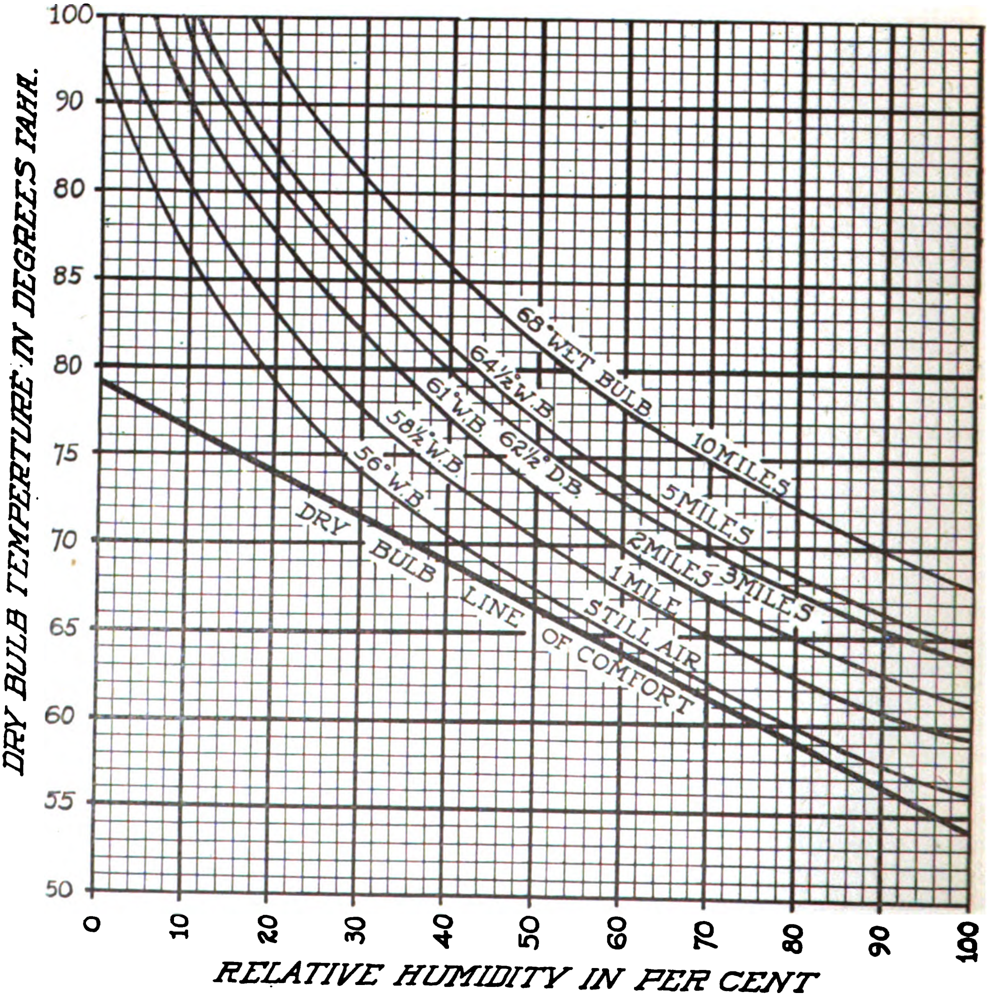
This formula can be solved for either H or T if the other is assumed.

Thus at 70° temperature, the desirable humidity is 36%, while at 65° we can stand 56% humidity with equal comfort.

A careful inspection of this chart and a little experimenting with the formula. shows that with the increase of 1° of temperature or of 4% humidity the discomfort is equal. To apply this to the matter of temperatures above 79° or below 54° it is only necessary to take the humidity reading obtained at the time in question, find the temperature which will give absolute comfort with that amount of humidity and subtract this temperature from that actually obtained, thus obtaining the number of Fahrenheit degrees above the comfortable point under those conditions, or, in other words, the number of degrees of discomfort.

The most comfortable temperature based on the above formula for any percentage of humidity is as follows:

Relative Humidity Per Cent.	Comfortable Temperature, Degrees Fahr.
0	79
4	78
8	77
12	76
16	75
20	74
24	73
28	72
32	71



"DEGREE OF DISCOMFORT" CHART.

Relative Humidity Per Cent.	Comfortable Temperature Degrees Fahr.
36	70
40	69
44	68
48	67
52	66
56	65
60	64
64	63
68	62
72	61
76	60
80	59
84	58
88	57
92	56
96	55
100	54

Under ordinary conditions the outside humidity usually ranges from 50% to 80% and supposing a temperature of 90° is recorded with 60% humidity it is plain that the ideal temperature at 60% humidity is 64° F. and the degrees of discomfort are therefore 90 — 64, or 26°; whereas if 87° were recorded with 80% humidity the ideal temperature under the 80% would be 59° and the 87° (actual) — 59° (ideal) would be 28° of discomfort.

This difference should be known as "degrees of discomfort" and should furnish a reliable basis of comparison.

To check this it is only necessary to remember that 4% increase in humidity is equal to 1° rise in temperature. Thus the 87° and 80% humidity is a 20% increase in humidity over 90° and 60% or is equivalent to a temperature of

$$87 + \frac{20}{4} = 87 + 5 \text{ or } 92^\circ$$

showing 2° increase in discomfort, which checks exactly with the result given.

It is becoming, however, a more and more recognized fact that with outside air conditions a breeze of greater or less intensity is quite likely to be encountered. Under such conditions an allowance must be made for the air movement and some other method used, either to modify the result obtained by the method just explained, or an entirely different basis of comparison used.

Investigations along this line have demonstrated in a matter reasonably conclusive that under certain velocities of air movement, at a given dry bulb temperature, a person will be most comfortable when the wet bulb stands at a certain level.

Experiments by the same authorities already quoted show that for various velocities of air movement the wet bulb must be about as follows:

COMFORT RELATIONS

Velocity of Air (Miles per Hour)	Wet Bulb Temperature (Degrees F.
Still Air	56
1	58.5
2	61
3	62.5
4	63.5
5	64.5
6	65.5
7	66.
8	66.5
9	67.
10	68.

Having the proper wet bulb temperature for a given air velocity and dry bulb it is a simple matter to determine what percent of humidity must accompany this state since the relative humidity governs the depression of the wet bulb.

In Fig. 1 the dry bulb temperatures are plotted vertically and the relative humidity percentages horizontally. On this chart are laid out curves giving certain wet bulb temperatures, these curves covering the proper wet bulb readings for still air, air at 1 mile, 2 miles, 3 miles, 5 miles and 10 miles velocity.

Thus, for the example previously quoted with 90° and 60% humidity—still air—the proper humidity is read by following the 60% line up from the bottom toward the top until it intersects the "still air" line and then reading at the left of the table the proper temperature—or about 65°. Therefore 90° — 65° = 25° excess or 25 "degrees of discomfort." And for 87° and 80% relative humidity the proper temperature should be 60° thus giving 87° — 60° = 27° of discomfort which results closely approximate those obtained by the first method. If a 2-mile wind had been blowing on the day with 87° and 80%, however, the proper temperature read from the "two-mile" curve would then have been 65° and the degrees of discomfort 87° — 65° or 22°, showing that a slight breeze would render the 87° day more endurable.

On Fig. 1 the straight diagonal line has been laid in to show the relation between the results obtained by the first method and the curves obtained by the second method, together with the allowances for wind velocity.

◆

Development in Heating and Ventilation During the Past Five Decades

In a review of the advances made in the art of heating and ventilation, contributed by Werner Nygren, C. E., to *Record and Guide,* Mr. Nygren says, among other things:

Air is the oldest of the three mediums used as heat carriers. Before water and steam were even thought of for this purpose, hot air or furnace heat was introduced and distributed in about the same manner as is done with the furnace-heating systems of the present time.

In the natural order of things, the first steam and water heating systems were of a home-made order. At the outset or pioneer period of the modern heating, there was not only the lack of the present-day knowledge gained by experience, but also the uncertainty of what material was best suited for pipes, heaters and boilers. The piping used was mostly made up of a hub-jointed cast-iron pipe, with caulked joints, assembled in about the same manner as our present cast-iron drain piping. Radiating surface was also made up in this manner and the boilers were either made specially for each installation according to the designer's own notion or else such available types of boilers as were then in use for operating steam engines were selected for this duty.

One of the earliest improvements was the introduction of the wrought-iron pipe assembled by screw joints and flanges and the use of wrought-iron pipe coils. A further step towards refinement was made by the invention of the radiator, which first made its appearance in the early fifties. Quite unlike most other innovations, the radiator in its earlier form was so efficient that but a very slight increase has been possible in all these years.

Indirect heating, like the direct method, was first accomplished with pipe coils. Indirect radiators made of cast-iron came into use about 1860. The original pattern, known as the "pin" pattern indirect radiator, is still being manufactured and used in competition with numerous other types of more recent design.

SECTIONAL CAST-IRON BOILERS FIRST MADE ABOUT 1850.

The first sectional cast-iron boiler of the type at present used for steam and hot water heating was made about 1850, but did not come into general use until in the early sixties. This has no reference to the power boilers of the sectional water-tube type which were conceived prior to the year 1800, but were not widely used until some time later and were of but little merit until in the sixties, when they began to develop along the lines of their present-day form.

LITTLE CHANGE BETWEEN 1860 AND 1888.

During the time that elapsed between the introduction of radiators, sectional boilers and other specialties which gave the steam heat its present character and until about 1888 the demand for this form of heat was greatly increased without any noteworthy changes in its application except that exhaust steam more and more came into use. At the end of this period, however, something happened which gave steam heating new impetus and added prestige, viz., the invention of automatic heat control and the introduction of specialties for vacuum heating a few years later.

THE ADVANCE OF VACUUM HEATING

Vacuum heating, which first appeared in the early nineties, came very rapidly into use in steam-heated buildings, equipped with power plants, because it provided an effective method for distributing the exhaust steam for heating without undue back pressure on engines, pumps, etc.

While the basic patents of the system remained in force, the appliances used in connection therewith were sold to the trade together with licenses for operation of the systems in the buildings for which they were bought. Lately, and since these patents have expired, the appliances are sold without any operating rights and incidentally with greater competition and much less claim for economy in operation than formerly was the case. This is not intended to imply that the use of vacuum as an agency for induced steam circulation that reduces back pressure is not fraught with a certain economy or that this economy has been reduced by the influence of competition. On the contrary, the latest appliances of the older systems now in existence are more efficient than ever.

RETURN LINE AND AIR LINE SYSTEMS.

From the very beginning there have been two types of vacuum systems in use. One of these systems, known as the return-line system, is used very extensively at the present time. The function of this system is to expel both air and water of condensation through an automatic return valve attached to the outlet of each radiator and heat source of the heating apparatus. This valve discriminates between the steam which is to be retained and the water and air which are to be expelled. In this system the entire return piping is under suction from a pump which maintains a vacuum as needed and pumps the condensation water and air to a separating tank, whence the water is then returned for boiler feed. A modification of the vacuum return-line system is what is commonly known as the open return-line system, which differs principally in that the water of condensation and the air with it are discharged by gravity directly to the separating tank, the vacuum pump being omitted.

The other vacuum system, which also is in use at present, is known as the air-line vacuum system. The function of this system is to expel air from each radiator and heat source served by the heating system through an automatic air valve which discriminates between steam and air. The vacuum, which in this system is confined only to the air lines, was first produced by a steam ejector discharging the air to the atmosphere. Lately, however, this system is as frequently operated by vacuum pump as ejector. The air-line vacuum system is best suited for one-pipe heating systems, although it is occasionally used also in connection with two-pipe systems. The vacuum return-line system, however, is only applied in connection with two-pipe systems.

MECHANICAL VENTILATION OF BUILDINGS A COMPARATIVELY RECENT DEVELOPMENT.

Little was done towards the application of mechanical ventilating until recent years, although it appears from old records that ventilating fans of crude form were in use more than 250 years ago for ventilating mines. Up to about 1870 fans were used mainly for special industrial processes and, with few exceptions, the ventilation of buildings as we know it today was either ignored or made to depend upon natural air movement secured by physicial properties of the atmosphere.

When consideration was first directed to the application of mechanical means of ventilation, the largest and most prominent places of assembly naturally received the first attention. To begin with, however, the use of mechanical devices was usually an afterthought and resorted to after the buildings were completed and when it had been found by bitter experience that the more primitive method of ventilating by heated shafts and chimneys could not produce satisfactory atmospheric conditions.

The House of Commons in England affords one of the earliest European examples of this kind. After many attempted improvements of the ventilation of this building the idea of moving the air by mechanical means was finally conceived in 1736 and a centrifugal fan was installed, which remained in service until 1820.

Another and more recent case was the U. S. Custom House in Boston. Bids for mechanical ventilating apparatus for this building were advertised for in 1846 after the building had been erected. The apparatus then installed incorporated a steam-driven fan, which was, perhaps, the first of its kind in this country.

The next fan installation appears to have been that in the Utica, N. Y., Insane Asylum. After this mechanical ventilating apparatus came into use more rapidly, until the present stage of development has been reached.

Fans of the present type did not come into general use until in the seventies when the self-contained steel-encased fan was put on the market for ventilating purposes. The introduction of this type fan, together with the development of the steam-tempering coil and the improved method of operating ventilating fans with steam engines driving directly on the fan shafts, gave the fan practice a new character. In later years electric motors have gradually taken the lead over steam engines for the operation of ventilating fans, on account of their greater convenience in operation and attendance and because motors lend themselves more readily for installations in out-of-way places than steam engines, besides which they can be made to operate practically without any noise or vibration, which is usually essential in ventilating work.

In our modern buildings space conditions must be carefully considered and conserved in order to find room for all the appliances and machinery that goes to make up the mechanical equipment. This situation has crowded out the cone fan as a supply blower in favor of its own offspring, the steel-encased centrifugal fan. For the same reason it has also been superseded as an exhaust fan by fans of more suitable types.

For exhausting air, both the so-called disc (or propeller) fan and the centrifugal fan are used. The former has gradually gained in favor on account of the comparatively little power this fan uses when handling air at low velocities as is the case with most of the present-day exhaust systems. It also offers less hindrance to the escape of the air by natural draft when not operated; a valuable feature in exhaust systems terminating at the roof, which is the case in most installations.

The origin of the principle on which the disc fan is founded dates back to the time of the ancient Archimedes screw. At the present time there are several forms of disc fans which are variously used for exhausting air, for producing air currents, for fanning effect and as local ventilators set in the wall openings. The disc type fan is, however, but very seldom used as a blower fan inasmuch as it is incapable of creating the higher pressures usually encountered in air-supply systems.

DEVELOPMENT OF MULTIBLADE FANS

The blast wheel of the original steel-encased centrifugal fan was of the paddle-wheel type. The more compact "multi-blade" type of fan wheel which came into use in 1908, made the fan housing less bulky, an advantage that was quickly appreciated and soon made this newer type fan very popular.

Apart from the various other improvements that have been made from time to time, the following new features might be mentioned: The cooling of indoor atmosphere by refrigeration, well water and water spray; the introduction of the air washer for cleansing the air and the invention of the steam humidifier and the automatic control of both temperature and humidity.

CHEESE CLOTH SCREENS AND AIR WASHERS.

The old method of filtering air through cheese cloth is still in use for screening out dust and other mechanical impurities. The common practice about thirty years ago was to make up this filtering medium in form of bags, but the more modern method is to stretch the cheese cloth on vertical frames set in V-shaped holders, thus securing the requisite filter area in a more compact form.

The air washer as applied to ventilation work came into use about 1900. The steam humidifier, together with the automatic humidity control by the humidostat, appeared two or three years before. The steam humidifiers now in use are of two types, one causing the evaporation of water from a pan placed in the air passage by means of a steam coil in the water and the other releasing low-pressure steam directly to the air through perforated nozzles covered with lamp wick material.

MASONRY AIR DUCTS

The old method of conducting air for ventilation through masonry ducts and flues formed in the building construction is but seldom resorted to at present. Ducts and flues made of galvanized iron are instead used for this purpose because of their greater efficiency due to decreased friction, decreased air leakage and increased cleanliness.

PIPE COVERINGS.

The precautions which had to be taken against undue heat losses and disagreeable effects from the hot pipes, flues, etc., have brought into use various forms of non-conducting covering. Among the first materials used for this purpose was hair felt, a covering material which consisted of cow's hair and which, when carefully applied, provided a very efficient nonconductor. It was found, however, to have one very serious defect,—i. e., under the action of heat vermin bred rapidly in this material. Its use as an insulating material for hot surfaces is therefore now limited mostly to temporary covering of pipes during building construction operations. The modern covering both for pipes and other hot surfaces is mostly made of mineral substances, such as asbestos, magnesia, diatomaceous earth, etc. Covering for pipes and fittings is made up in sectional form and canvas jacketed whereas covering for other purposes is usually made in blocks or sheets for convenient application and either finished off with plastic cement or encased in canvas, glued or sewed on.

The matter of non-conducting covering is given very careful consideration in present-day practice, as it is realized that proper protection in this respect has an important bearing not only on the economy of operation of heating and ventilating apparatus, but also on the results to be accomplished.

SLOW DEVELOPMENT OF SCIENCE OF HEATING.

From the scientific aspect a great deal of valuable information has been gathered during the evolution of the heating and ventilating practice. The science on this subject did not develop very rapidly, however. Its path was beset with conflicting theories and whims which had to be eliminated before data of scientific and practical character would be accepted. Some very simple facts and theories were literally dragged forth from obscurity by repeated failures in obtaining uniform results, because of the fact that physical laws had been overlooked.

A striking example of this is the old method of sizing radiators on the cubic foot basis. For a very long time the simple and obvious theory that the heat requirements of a room are in direct proportion to the room exposure was lost sight of, and until this theory was applied it was customary to allot heat in direct proportion to the cubic contents with an arbitrary allowance for extra severe conditions. This method occasionally and repeatedly resulted in huge failures, but is still used to some extent.

Meeting the High Cost of Heating and Ventilating Apparatus

A Discussion Based upon an Article in the March, 1918, Issue, Advocating the Use of Pipe Coils as an Economy Measure.

By GEORGE T. MOTT.

In the study or application of heating equipment, a reduction in cost of installation without injury to the successful plant condition, is to be commended. This question, therefore, is one which exihibits an interest not only in the welfare of the trade, but also in that of the investor.

The development of heating equipment of all kinds, and this can embrace every functioning device, whether a radiator, boiler, fan, motor or valve, has been developed not only commercially but scientifically with a view to its capacity of output, its economy of operation, its stability and its initial cost. These features are of necessity synonymous with progress, and progress, in a sense, is synonymous with commercial success.

To revert, as was proposed by a writer in THE HEATING AND VENTILATING MAGAZINE for March, to a type of heating equipment (pipe coils), at its zenith of popularity perhaps 25 years ago, does not apparently imply a very high order of faith or confidence in the development of radiating surfaces during the intervening period.

LARGE GLASS AREAS LEAVE LIMITED SPACE FOR HEATING SURFACES

The large glass areas required by law for school work and, by the law of economy, for other classes of building, provide but limited areas for the installation of heating surface. This large glass area is also a potent factor in the quantity of heating surface re-

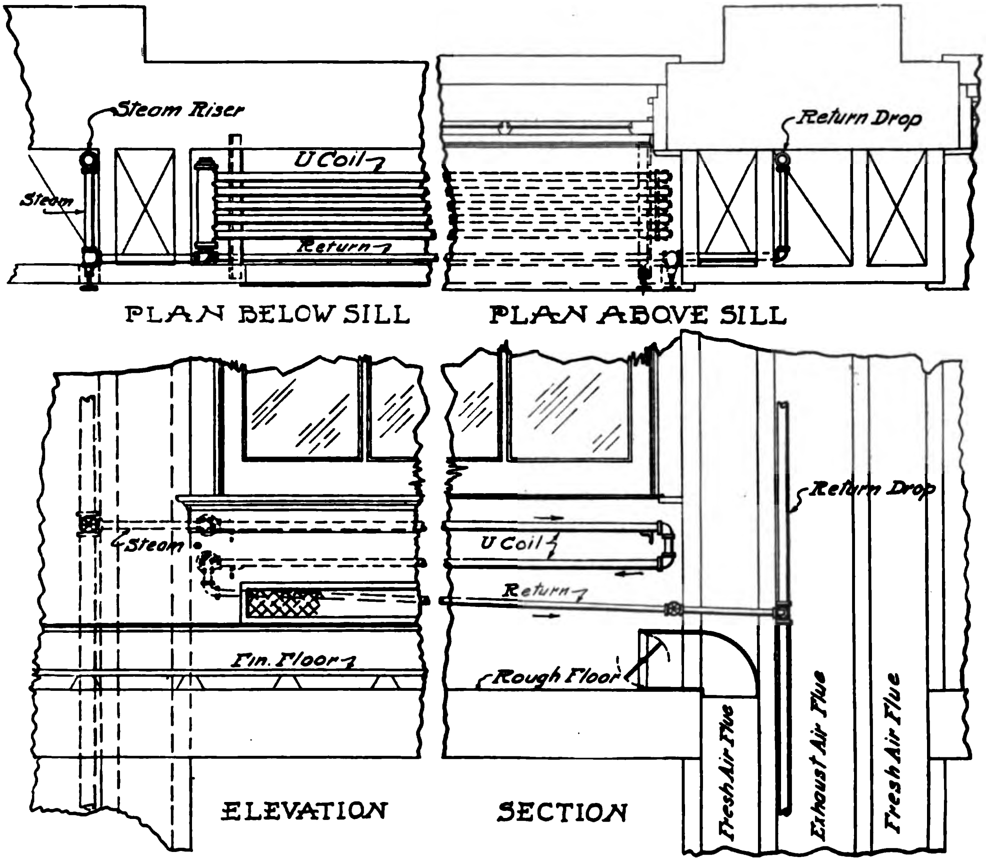


FIG. 1.—SCHEME PROPOSED FOR USING PIPE COILS IN HEATING SCHOOL BUILDINGS.

quired, so that the four or six-pipe 1-in., 1¼-in., or 1½-in. pipe coil, as previously used, no longer meets the requirements.

The item of space condition, always a factor to be dealt with, is not one easily met by the pipe-coil proposition. The suggested coils illustrated in the article referred to, would not meet the stated requirements. In any event, the scheme outlined, in which coils are placed underneath the window-sill, in the path of an air supply, would require a recessed space beneath the window to enable the coil and ducts to be properly enclosed.

In the smaller school, in which this type of installation would only be applicable, there is little opportunity to provide sufficient recess depth to install the necessary flue and coil surface and there are few, if any, communities which provide schoolrooms of such dimensions as to make it permissible to take up so much space from the schoolroom. In most instances, the municipal or State ordinances prohibit the extension of such projections into the aisle beyond a very limited degree, in consequence of which it is necessary, in providing sufficient heating surface for any particular building of modern construction, to use a type of surface of materially greater compactness than pipe coils. If this surface so substituted for the pipe coil, should be of equal or greater thermal transmission value, and be easier to handle and erect, and if the first cost of this product should not exceed that of the pipe coil, the problem would be solved by a process of elimination.

WALL RADIATION AS A SUBSTITUTE FOR PIPE COILS

It is presumed, from the comparative B. T. U. figures given in the article under discussion of 300 versus 250, that the cast-iron radiation referred to is of the type generally known as column radiation. This being the case and for comparison with, say, a five or six-pipe 1-in. or 1¼-in. pipe coil, the ratios would be absolutely correct. The use of wall radiation, however, in this connection, seems not to have been considered.

As far as the efficiency of wall radiation is concerned, it has been shown in successive series of tests made periodically and covering many years, that the efficiency of a wall radiator of approved type is equal, in every respect, to that of a pipe coil, and, as a matter of fact, in many instances and circumstances, it has been found to exceed the pipe coil. In the writer's experience, it has usually and more frequently been found possible to reduce the amount of surface specified when using wall radiation below that of the pipe-coil surface. When comparisons are drawn, between the transmission value of wall radiation as against the box coil and under gravity conditions, the wall radiator exhibits a marked superiority over the pipe coil, running as high as 30%. This is generally due to the increased convective value of the wall radiator.

HIGH COST OF PIPE AND LABOR A FACTOR

Another point to be considered in discussing the economy of pipe-coil surface is that the material for pipe-coil construction of today, is excessively high, and both pipe and labor are almost equally scarce, in consequence of which both of these features carry a premium which does not occur in the construction of wall radiation. An enormous shrinkage in the quantity of small-pipe on the market and the urgent need for pipe in our industrials and for ship building would seem to carry with it a demand to use cast-iron surface wherever possible, if only as a patriotic measure. But where these measures involve also a greater economy, the answer seems imperative.

Actual current installation costs, based on a comparison between pipe coil and wall radiation, using, in the first instance, a six-pipe 1¼-in. coil, approximately 100 ft. in length (which is the most favorable pipe coil which it is possible to construct from a cost point of view and based on the low market quotation applicable to carload lots), compared with a well-known make of wall radiation at the recent advance and at sheet, shows a reduction in the cost of erected wall radiator units in excess of 1 and ½ cents per square foot. Moreover, it is obvious that the cost of handling and erecting wall radiation will be far below that of the labor expended in the building and erecting of pipe coils.

Where the features of relative appearance and stability are increased and where the depreciation and repairs are correspondingly decreased, and where the wall radiation lends itself so admirably to the space conditions permissible in the newer type of buildings, it would appear that the aggregate benefits to be derived from the installations of this surface, over the old-time pipe coil, were manifold. It is also true that the several features and conditions outlined in the article in question, for general reduction in the cost, relating to arrangement and connections, valves, etc., are equally applicable in every respect to wall radiation, and the type of plant selection is equally optional.

It would further seem, in comparing the sketches with the current practice of installing direct-heating surface in a classroom, providing for such thermal losses as occur in a building, that it would not be a matter of economy to install an amount of surface which would be employed only in raising a given volume of air through a temperature range of 10° when the installation of direct wall radiation would be capable of offsetting the thermal losses referred to, by the delivery of air under gravitation through a temperature increase of from 35° to 40°. It would further seem that no economy would result with such a scheme as proposed since no provision has been made for heating during the early morning period when it is necessary to bring the school up to a living temperature when not occupied. It is obvious that if this coil surface is so installed as to give increased temperature range of but 10% under the velocity due to the fan action, its operation during the early morning hours under gravitation would be, to all intents and purposes, relatively negligible. This would argue the necessity of operating the plenum system not only during the period of occupancy but also during that period of time previous when the warming of the building to a livable temperature was being accomplished.

Therefore, as the scheme suggested does not provide the flexibility necessary to cover the several conditions of operation implied and as first cost appears to be the only point of consideration, it might be suggested that the idea be carried a step further by having the direct surface, so called, entirely eliminated, and the entire equipment grouped into a single plenum chamber.

It is a matter of questionable economy, to substitute brick for sheet metal flues, not only as to first cost, but also as to space conditions, as it is obvious that a galvanized flue of dimensions corresponding to those of a brick flue occupies naturally less space, and this space economy does not appear to be incorporated in the proposed scheme, where the group of several flues in brick would occupy practically the same amount of space required by the larger galvanized flue.

ANALYSIS OF PROPOSED SCHEME

An analysis of the proposed scheme would appear as follows, basing our calculations, on a small school, and making no provision for an auditorium, halls, or other adjuncts, and accepting, in each instance, 40-pupil classrooms on the usual 30 cu. ft. basis and assuming that the entire quantity of air delivered to each classroom shall pass through two successive temperature steps and through a total range, at zero, from zero to 100°, and successively through the surface installed directly in the classroom, from 100° to 115° (the 70° figure quoted in the article as the final temperature of air delivered to the classroom being insufficient to maintain 70° in zero weather) and assuming, further, that the particular classroom under analysis shall contain three of these discharge units.

We then have the elements appearing as follows, and to preserve the parallel in the comparative figures given in the article, we shall, although it is rather high, accept the 400 ft. velocity indicated at the register face and tentatively specified for delivery through the coil surface suggested.

Acting on this assumption, we find that each of the three units specified calls for 400 cu. ft. of air per minute, and, as the velocity specified is also 400 ft., this would require 1 sq. ft. of free area at the grill or delivery inlet to the classroom. As grills ordinarily interpose from 30% to 50% of equivalent frictional area to intercept the flow of air, the register openings must necessarily be increased in this proportion and to further conform to the suggestions given, it is assumed that the register openings will be increased 30% and will be 4-in. in width, which will give us, for three units as proposed, a length of 46.8-in. in each case and this may be assumed also to equal the length of the individual pipe, or the length of the coil in question.

The steam temperature implied, is evidently that corresponding approximately to 5 lbs. working pressure, or 227°, in consequence of which the transmission value of the pipe coil in question, delivering air through a temperature range of from 100° to 115° would be approximately 418 B. T. U. per hour. On this basis, the total amount of coil surface required in each unit would be 15.6 sq. ft. and to maintain a free area of 1 sq. ft. as required making further provision for frictional resistance, and with the necessary depth of coil to carry through the temperature range implied, would require a coil six pipes in depth, giving a transmission factor of approximately 3.5, under fan control.

The effective value of this surface however, for heating during the early morning and noon-time periods, would be materially reduced, by reason of the necessity for operating under gravity for economic reasons, and due also to the enclosed condition of the surface, and is further accentuated by the low window seat enclosure. This reduction would be in value not less than 20%, and, unless carefully arranged, much greater, making effective but 80% of the actual surface. Under this condition, the co-efficient of transmission would be approximately 1.6 B. T. U.; less than that of full standing wall radiation.

Accepting the statement given in the original article, as to the requirement for thermal losses only of 130 sq. ft. of direct surface, and accepting also, the 250 B. T. U. assigned thereto, we find that for the three units proposed, consisting of 43.3 sq. ft., each approximately, we have an assumed total radiation value to offset the thermal losses only, of 10,825 B. T. U. As the coil surface in question contains in the total but 37.44 sq. ft. in effective surface, there is obviously a deficit for the early morning period, of approximately 70%. [With the coil surface only in operation and with an external temperature of zero, the internal temperature would not rise above 30°. It would seem from this, then, that the proposed proposition is not practical on the basis of the division as established, as it is evident that during the unoccupied periods it would require that the fan system be in operation 60% to 75% of the time as expressed in school-days, and much in excess of the requirements when operating under direct auxiliary operation, or, in other words, with free standing wall radiation.]

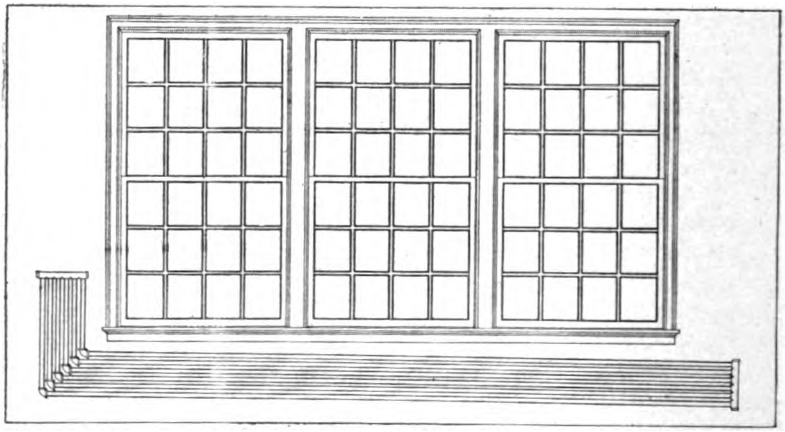


FIG. 2.—SPACE CONDITIONS WITH PIPE COILS.

Figs. 2 and 3 show respectively the space conditions as they exist in connection with free standing wall radiation and pipe coils with similar amounts of surface and show also, as compared with Fig. 1, from the article in question, the relative limited space occupied by the wall radiation in relation to wall coils, and the very material consequent saving in floor areas.

The suggested ventilating equipment, as a part of the proposed scheme, will apparently also bear a careful analytical inspection. The pains-taking comparisons shown for the reduction of duct metal used would seem to indicate that the saving effected in this reduction, would be, in a ratio, in direct accord with this weight reduction. This, however, is far from being the case.

It is readily observable that the labor cost of building, say, an 8.5-in. x 8.5-in., a 7-in. x 7-in. or a 6-in. x 6-in. duct, as against that of, say a 12-in. x 12-in., is, for all practical purposes, eliminating the additional weight to be handled, exactly the same, and, while it is highly commendable to effect the saving shown in metal, this can only economically be accomplished where no other influence can be applied, that may in any degree offset this.

There is, however, in the delivery of air at high velocities, a frictional factor of very considerable import in the relation of high to low velocities. This is exemplified in the drafting room adage, "As loss of pressure varies as the square of the velocity, large ducts and consequent low velocities are most economical."

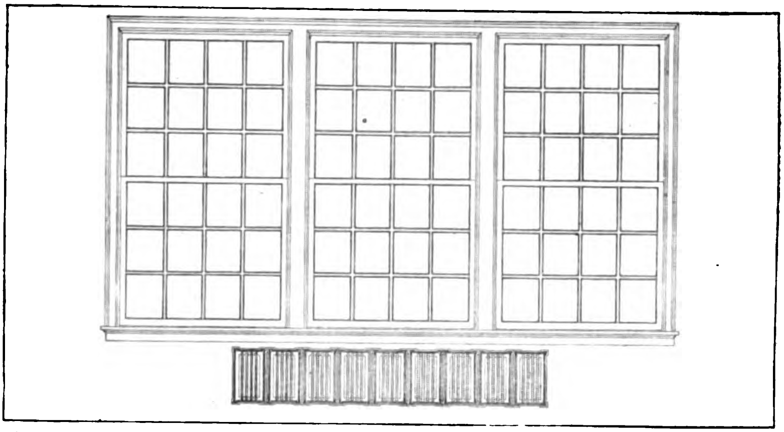


FIG. 3.—SPACE CONDITIONS WITH WALL RADIATION OF EQUAL CAPACITY.

Let us, for comparison, assume a system handling, say, 7,250 cu. ft. free delivery, operating against a 0.2 oz. pressure. For the purpose of maintaining a low velocity we will designate a 90-in. steel-plate fan with a 54-in. wheel, delivering at a velocity of approximately 1160 ft. per minute.

For direct comparison with this condition it is now proposed that we double our velocities, and as the resistance varies as the square of the velocity, the operating pressure is now increased in this ratio to 0.8 oz. for this similar service. Under this condition, let us assign a 70-in. fan with a 42-in. wheel and delivering under the 0.8 oz. pressure, and free delivery 8760 cu. ft.; the velocity in question under this condition being 2190 ft. or practically double that of the fan previously noted, while the actual outlet delivery is practically the same.

The motive power required in each instance is for the 90-in. fan at 1000 ft. velocity, approximately 1.1 h. p., and, for the 2000 ft. velocity, 4.54 h. p.

Calculating, say, for a school proposition, on a 6-hour operating base per day, and for a working season of seven months, and on a basis of 6 cents and 5 cents per K. W., for the small and large motors, respectively, we have, in the first instance: under the 1000 ft.

velocity, a power operating cost per season of $53.10; in the second instance, under the 2000 ft. velocity, a power operating cost per season of $182.00, making the net increased cost for the higher velocity approximately $129.90. This on an investment basis of 5% would require a reduction in the initial cost of the equipment approximating $2600.00.

The proposed economy is evidently suggested on the basis of an advantage to be taken in the capacity of the coil surface installed in the classroom by reason of augmented transmission value, due to the direct delivery of the fresh air at a comparatively low temperature and high velocity immediately over and through same, and while this condition would obtain, and would also be equally true of any other surface, there is in the application of this to schoolrooms, a material handicap by reason of the absolute necessity for maintaining low velocities at the point of delivery, which velocities should not in fact exceed from 220 ft. to 300 ft., to say nothing of extremes in operating requirements at various periods.

It is possible, however, as shown, if desiring to put into effect a first-cost proposition, to obtain a materially increased transmission due to velocity, in the plenum chamber, and this would hold with any type of surface and is frequently done, but within limited ranges.

DIFFERENT SCHEMES SUMMARIZED

In conclusion then it would seem that the following schemes submit themselves in summary and are given in the order of cost, decreasing from No. 1 to No. 3, when combining first cost and operating charges, depreciation, etc.:

1. A plenum system with sufficient surface to heat from 0° to 100° under high velocities and with coil surface in the room sufficient to carry through an additional 15° range. This scheme involves a limited amount of plenum coil, an excess amount of coil surface for reheating when compared with the plenum coil, a small fan at high velocity, a large motor, limited control or flexibility, and a constant operation with high "overhead."

2. A plenum system with sufficient capacity to heat from 0° to 115°. As compared with scheme No. 1, this entails the elimination of reheating surface, a smaller amount of heating surface in the total, a fan of the same dimensions for high velocities, a motor of same dimensions, limited control difficult to maintain, and a constant operating "overhead" equal to No. 1, but with a marked reduction in first cost.

3. A plenum system of sufficient capacity to heat from 0° to 100°, with direct surface sufficient to offset the room thermal losses and entailing a low air velocity. With this scheme would be used hot blast surface of high transmission value and low resistance, wall radiation of high transmission value to offset room transmission losses, a greater amount of heating surface in the total for direct heating, a larger fan operating at a low velocity, a materially smaller motor, a thoroughly economic temperature flexibility, and a material reduction in "overhead" by reason of the gravity operation permissible during the time of unoccupancy.

To scheme No. 3 must be added, as shown, not only the advantage in control and flexibility to meet all periods of operation, but also the compactness due to the installation of the direct wall radiation.

It would appear further that the present working system of heating, as evolved through a long period of study and application and which embraces a combination of direct wall surface in conjunction with a plenum system, practically answers the question raised and justifies the adoption of this particular method of application from a point of economy.

Heating and Ventilating Equipment as Realty Fixtures

A Summary of Court decisions on the Removable Character of Such Appliances as Against Adverse Claimants.

By ARTHUR L. H. STREET.

The difficulty encountered in "Pigs is Pigs," in classifying guinea pigs under an express company's tariffs, was not greater than the difficulty the courts have found in the matter of determining the relation of heating appliances to the real estate upon which they have been installed.

Believing that readers of THE HEATING AND VENTILATING MAGAZINE will find a general survey of the more important of the reported cases on this subject interesting, because of the considerable importance of the questions involved, the writer will attempt in this article to show the trend of judicial authority on the right to remove appliances from premises on which they have been installed, including the right of a conditional seller to exercise a reservation of title as against a purchaser or mortgagee of the premises and the right of removal in other instances where one other than the owner of the premises claims an interest in heating and ventilating equipment.

It is well known that where a modern heating plant is built into a structure, and especially when it is done in the construction of the building, it is to be deemed just as much a part of the real estate as the doors and windows. From this it follows that, except as the seller may have perfected a mechanic's lien or have a mortgage upon the premises, as security for any sum due him, a mortgagee or purchaser of the real estate is ordinarily entitled to claim the plant as a part of the realty.

The cases which perplex the courts are those where heating plants are portable or semi-portable, as shown by the decisions referred to below.

In the case of Thielman vs. Carr, 75 Ill., 385, which was a suit to enforce a mechanic's lien against a building, it was objected that a furnace and pipes installed in connection with it could not be regarded as a part of the building. But the Illinois Supreme Court said: "It is believed that ordinary stoves and pipes have been always conceded to be personalty or mere chattels. They, as all know, are not intended to become, and form a part of the building. But with furnaces it is different, as it is known that they are intended to be permanent, and a part of the structure. They are seldom, if ever, detached from the building, so long as they last, whilst stoves are frequently moved and again replaced. Another difference is, that furnaces cannot be removed without taking them apart, and the intent must usually control. If, as is believed to be generally true, furnaces are intended to be permanent, and to become a part of the building, that would stamp their character, and require them to be held realty. It would seem to be as much so as a steam engine in a mill or factory, and we are not aware, that when placed in the building by the owner, it has ever been doubted that it thereby becomes realty."

But the court notes that this holding must not be regarded as inconsistent with the right of a lessee of premises to reserve the privilege of removing a furnace installed by him.

A CASE WHERE BOILERS WERE INSTALLED BY CONTRACTOR, BUT NOT PAID FOR.

In the New York case of Jermyn vs. Hunter, 93 App. Div. 175, plaintiff sued to recover possession of two large boilers and a hot-water heater which he had sold to a contractor for installation in a building, under agreement with the contractor that title should remain in plaintiff until payment of the price. Plaintiff knew that the equipment was to be installed in a permanent manner in a building not owned by the contractor, and the owners of the building had no knowledge as to the attempted reservation of title to the appliances. Under these circumstances, the Appellate Division of the Supreme Court decided that, as against the owners of the building and a purchaser of the premises at subsequent mortgage foreclosure sale, the heating apparatus became part of the real estate and hence was not recoverable by plaintiff, especially since the boilers had been bricked in, although they could have been removed without interfering with the main walls of the building.

The court found that the evidence showed the existence of the three conditions generally held by the courts as showing a permanent accession to real estate: (1) There was an actual annexation to the realty. (2) There was a purpose to use the boilers in connection with the realty. (3) There was intention by the owner to make them a permanent accession.

WHEN FIXTURES MAY REMAIN PERSONAL PROPERTY.

But the court said: "We do not overlook the fact that fixtures, annexed to real property in such form that they would pass as real property under a deed may, nevertheless, *by agreement between the owner and the person installing the fixtures, or the vendor of the same, continue* to remain personal property. * * * If vendors of personal property seek to make a conditional sale they should be required to deal with the owner of the property and not alone with the contractor without notice to the owner."

The opinion also refers to the Lien Law as affording sufficient security for sellers of chattels which enter into the construction of realty.

A furnace and boiler in a theatre building, resting upon a solid foundation and not removable without tearing away masonry, together with connecting pipes and radiators, were held by the Washington Supreme Court to have been real estate fixtures which passed to the purchaser under a mortgage foreclosure sale of the premises. (Filley vs. Christopher, 39 Wash. 22.)

And in Keeler vs. Keeler, 31 New Jersey Equity Reports, 181, it was held that steam pipes constituting part of a heating plant passed under a mortgage of the real estate, as against a prior chattel mortgage covering the pipes; they having been attached to a boiler, constituting a permanent fixture.

POSSIBLE INJURY TO BUILDING OFTEN A CONTROLLING FACTOR.

In the absence of other evidence on the question of intention to make a permanent installation of apparatus in a building, the fact whether or not removal can be effected without leaving the building in an injured condition is often controlling. But in the case of Newcastle Theatre Co. vs. Ward, 57 Ind. App. 473, it was decided that, in the absence of any showing of intent to make a permanent installation of a heating plant, the fact that holes would be left in floors where the steam pipes had passed through did not prevent a removal of the equipment as chattel property, the boiler not being attached to the real estate, except as it rested on the basement floor and was connected to the pipes, which were suspended from the joists of the building by hangers.

In the case of Stockwell vs. Campbell, 39 Conn. 362, it was declared, however, that although a hot-air furnace was not affixed to a building and was portable and held in place only by its own weight, the fact that a pit had been prepared for it, into which it fitted, constituted it and the connecting pipes a part of the realty so that those who furnished the furnace could enforce a mechanic's lien for their claim.

In the latter case of Rahway Savings Institution vs. Irving Street Baptist Church, 36 N. J. Eq., 61, this decision of the Connecticut court was relied upon as authority for the proposition that a similar furnace resting on the cellar floor of a church building constitued part of the real estate, in favor of a mortgagee of the premises. But the New Jersey Court of Chancery distinguished the Connecticut decision on the ground that it was based upon a conclusion that intention to make annexation of the furnace permanent was shown by making the pit in the basement, adapted in size and depth and for the express purpose of receiving the furnace whereas in the New Jersey case, the furnace merely rested on the floor, replaced stoves and was not installed in such manner as to indicate permanence.

"Now, while it is true," said the New Jersey court, "that it is not necessary to constitute an article a fixture that it be actually fastened to the freehold or something accessory thereto, * * * it cannot be held that the mere fact that a chattel is placed in a part of the house which has been adapted to receive it, will make it a fixture; for example, a bedstead in a house obviously would not be made a fixture by the mere fact that it was placed in an alcove made to receive a bedstead. And so, too, the mere fact that a stove or portable furnace is placed in a niche made to receive it 'will not make such stove or furnace a fixture.'"

RADIATORS AS DETACHABLE PARTS

There are three interesting decisions in which the character of radiators as detachable parts of heating plants has been considered.

In J. L. Mott Iron Works vs. Middle States Loan, Building & Construction Co., 17 District of Columbia Appeal Cases, 584, the loan company unsuccessfully sued to the restrain the Mott company from reclaiming certain radiators and valves which had been installed under a conditional sale contract by the latter company on premises against which the loan company held a mortgage given before the appliances were installed.

The court briefly discussed the abstract proposition whether radiators should be likened to gas fixtures, which are held by the great weight of judicial authority to be ordinarily removable as retaining their character as chattel property. But the opinion expresses no decision upon this point. The court merely decides that a conditional sale of radiators will give the seller, under his reservation of title until payment, rights superior to a prior mortgage upon the real estate; and that articles installed upon real estate may be held subject to chattel mortgage, as against a prior mortgagee of the real estate, where the articles may be removed without injury to the real property. This decision rested, however, upon the grounds that the radiators could be readily detached without injury to the building and without diminishing any security to which the real estate mortgagee was entitled to resort under its mortgage.

PENNSYLVANIA COURT LIKENS RADIATORS TO GAS STOVES.

In the case of Bank vs. North, 160 Pa. St. Rep., 303, the Pennsylvania Supreme Court decided that radiators are to be regarded in the same light as gas stoves, with the same right to hold them in ownership severed from the title to the real estate, regardless of the character of the pipes to which they may be attached.

MINNESOTA SUPREME COURT RULES THAT RADIATORS ARE PART OF REALTY.

The doctrine of this case was expressly disapproved by the Minnesota

Supreme Court in the case of Capehart vs. Foster, 61 Minn., 132, where it was decided that radiators forming part of a steam heating plant must be regarded as part of the realty, in favor of a mortgagee of the premises, as against the owner.

"These radiators were put in immediately after the building was erected. There is no reason for holding that the owner did not intend them to be permanently annexed to the steam plant, and therefore permanently annexed to the realty. He might remove or change them, and so might he remove or change the boiler or the furnace, which is also a part of the same steam plant. Such radiators are an essential part of such plant, and are rarely furnished by tenants or temporary occupants of buildings as a part of the furniture brought with them or carried away with them, but the owner who furnishes the rest of such plant usually furnishes the radiators also. When, under ordinary circumstances, the owner of the building attaches such radiators to his steam plant, it should be held that he intended them to be permanently annexed to the realty. We are cited to National Bank vs. North, 160 Pa. St. 303, 28 Atl., 694, which holds to the contrary. This case holds that such radiators are analogous to gas fixtures, and therefore not a part of the realty. By following the same process of reasoning by analogy you would strip a house of all modern improvements, and by continuing that process you would overturn the greater part of the law of fixtures."

From what has been said it will be seen that it is quite impossible to lay down a set of hard and fast rules that can be followed safely in every State. But it is hoped that this discussion will serve to increase the exercise of caution by those who seek to retain chattel interests in equipment installed upon realty, by suggesting the advisability of taking legal advice concerning local laws and decisions before risking much on this form of security.

It is clear enough that, as between the immediate parties to a contract, equipment may take the form of real estate or remain chattel property according to their agreement, and that persons having notice of such agreement will be bound thereby, but particular pains must be taken to avoid the possibility of some third person acquiring rights in the real estate upon the apparent faith of the particular equipment being a part of the realty.

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CHICAGO COMMISSION ON VENTILATION

School Building Heating and Ventilation

BY SAMUEL R. LEWIS.

School buildings are heated by direct methods, using stoves or steam or water radiators, placed in the rooms; and by indirect methods, under which the heaters, using furnaces or radiators, are placed outside of the rooms, warming air, which, displacing or mixing with the air in the rooms, maintains the necessary temperature.

When direct heating is adopted, the ventilation, when any is obtained, is arbitrary, usually according to the prejudices of the teacher, who manipulates the doors and windows. With stoves, the draft requirements of the fires cause a constant air change via the chimney, but not of sufficient volume to be classed as ventilation. Sometimes heated vent flues and jacketed stoves, using an air supply from outside, are provided, which give fairly good results when the temperature outside is below 40°F. This arrangement (Fig. 1), while very old, as the illustration indicates, is probably the most practical one known at

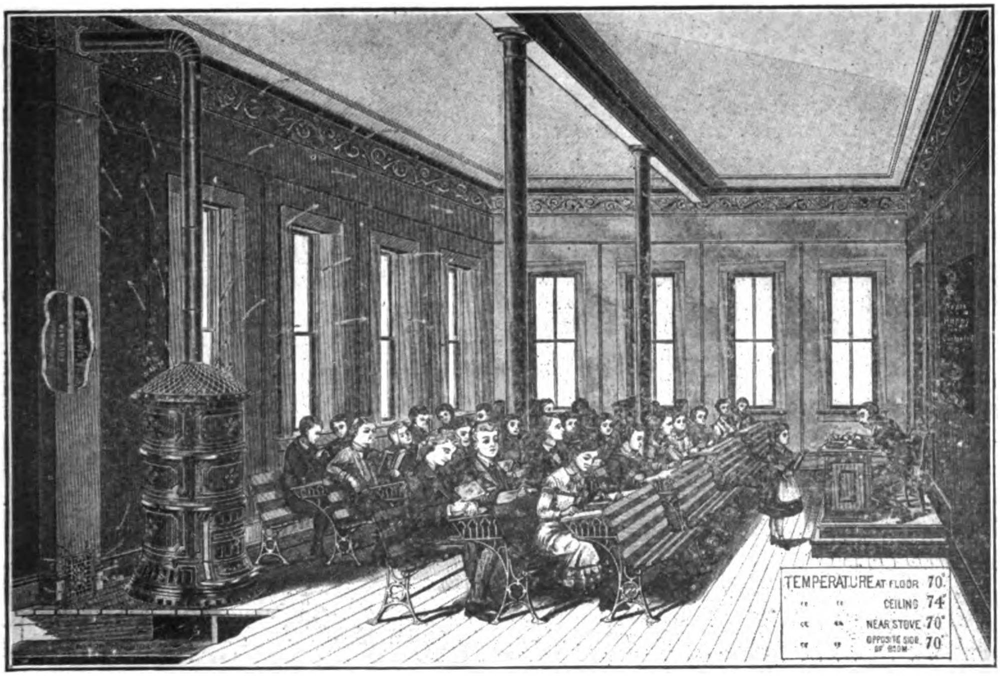

FIG. 1.

From a catalog published forty years ago. The vent flue is heated by the warm gases from the stove, and draws the air from the floor. Fresh air from outside replaces continuously the air removed. In all probability, there is considerably more variation in temperature than the illustration indicates.

present for one-room, rural schools. The worst condition as to ventilation obtains in school rooms heated with direct steam or hot water radiators, with closed windows.

A combination arrangement (Fig. 2), in which there are provided jacketed radiators, usually one for each class-room, and vent flues which are heated, comparable with the jacketed-stove scheme, is well known. Owing to the lower temperatures of the heating surface and the fact that the buildings may be heated by the direct radiators without opening the fresh-air supply windows to the indirect radiators, the combination arrangement is less effective than the jacketed stove, while subject to most of the short-comings of the latter. It is always difficult to control the temperature; the volume of fresh air handled increases as it gets colder outside; the heated chimneys are wasteful; the air distribution within the room is inefficient; and the system as a system will not operate to much advantage when it is warmer than freezing outside.

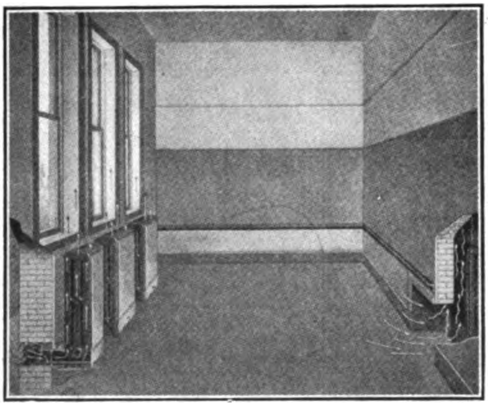

FIG. 2.

Section through a school-room showing direct-indirect steam heating and ventilation. The fresh air entering through openings under the windows, rises around the radiators, which have jackets, and finally leaves the room through the vent flue on the right, which flue, it will be seen, is heated by a radiator. Observations of such plants in operation show them to be profoundly affected by wind conditions, and therefore unreliable.

WHEN WINDOW VENTILATION IS PRACTICABLE.

With any method of direct heating, an expert, giving practically his undivided attention to the matter, may achieve fairly good ventilation by manipulating the windows. Careful tests of many window-ventilated buildings operated by the teachers under very consistent instruction and supervision, however, demonstrate the following:

Window ventilation for school rooms and for rooms in general, is practicable only—

A. When the walls and floors and furniture and occupants are warm.

B. When the room so ventilated happens to be on the windward side, or when lack of wind movement is compensated for by considerable temperature difference between the inside and outside.

C. When all doors to corridors and cloak-rooms are closed, since if they are not closed the cardinal features of window ventilation cease to exist.

D. When the teacher will watch the thermometers and adjust the windows every few minutes.

E. When no direct cold drafts strike the occupants except perhaps in their faces.

In explanation of the foregoing, please understand that we are discussing an ordinary class-room, having perhaps six windows and, say, forty occupants. It will be necessary, in order to approach the established standard of purity (6 parts CO_2 per 10,000), to introduce and remove around 1200 cu. ft. of air per minute. Presumably three windows can be considered as inlets and three windows as outlets, provided we have a corner room. To heat the 12000 cu. ft. per minute from, say, 30° F. to say, 65° F., will require under the inefficient contact conditions, at least 180 sq. ft. of steam radiation in addition to that normally provided to offset losses and leakage. Not one window-ventilated class-room in a thousand has anything approaching such an excess amount of radiation. It is safe to say that the opening of windows in all such buildings is intermittent, governed by temperature and humidity conditions, and that practically under no conditions is the ventilation so obtained worthy of the name.

When indirect heating, operating without fans and without any direct radiators, is adopted, the air supply is warmed outside of the room to a temperature sufficient to prevent complaint from drafts, and high enough to furnish the heat lost through glass and wall exposures. Such systems are sure to furnish some sort of ventilation, as the heat cannot reach the room without air to carry it. This system of heating requires that a reasonable amount of skill be exerted in its design and operation, and is sensitive to variations in wind and outside temperature.

To alleviate these conditions the mechanical indirect system of heating and ventilating was developed, with power-driven fans forcing the air movement, and greatly improving the results.

OPERATING COMBINATION SYSTEMS.

A further combination is to add direct radiators in the rooms, and to reduce the temperature of the heated air, but this is a dangerous procedure, since with the radiators present the building may be heated and occupied, without operating the fans or obtain-

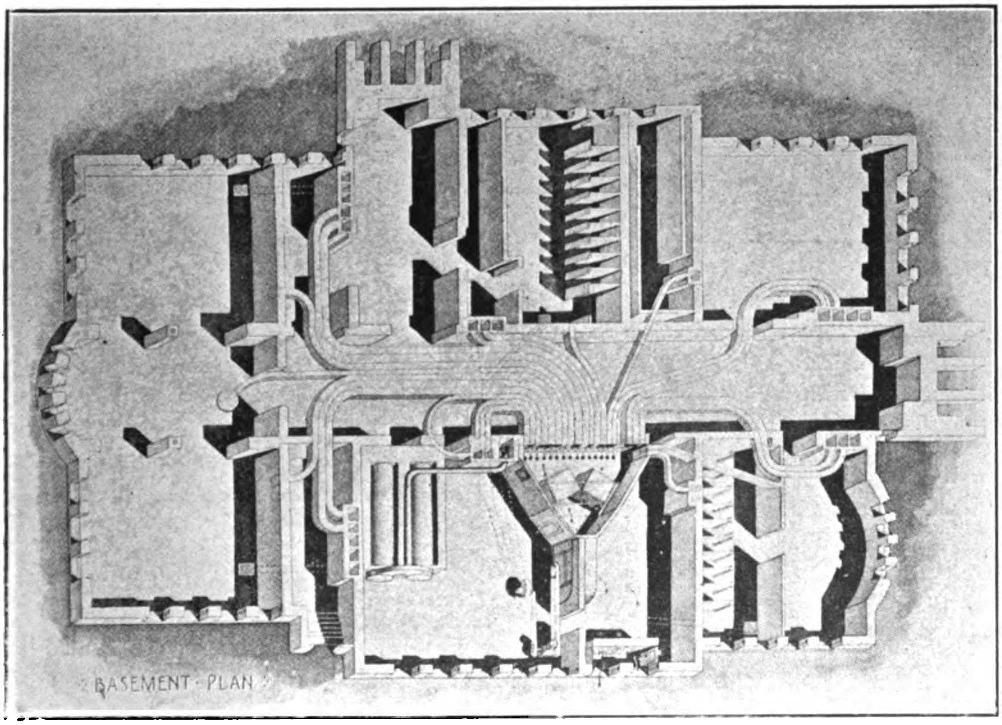

FIG. 3.

An all indirect, mechanical system of heating and ventilation, with a separate duct to each room from a central pressure chamber. At this chamber two temperatures of air are available, both under fan pressure, one for warming the rooms when they are too cool, the other warming only enough to prevent drafts, and for cooling the rooms after they become too warm. Air of constant volume, but varying temperature, may be delivered through any duct regardless of the temperature of the air delivered through any other duct, the temperature being varied by mixing dampers at the central chamber.

ing any ventilation. When separate ducts, each provided with a mixing damper, supply each room, as shown in Fig. 3, the temperature in the room can, of course, be maintained at any reasonable point. A popular measure, when auxiliary direct radiators are installed, is to provide a trunk line duct carrying air at one temperature to all of the rooms (Fig. 4). Consider then, a north room with large window area and few occupants, with a north wind outside; and a south room, sheltered, in the sunshine, and crowded with people. The air delivered must be cool enough not to overheat the south room, which would have all its radiators cold, yet warm enough not to chill the north room, which would have all its radiators hot. These considerations have proven that with a trunk line air supply and auxiliary direct radiators, we must provide for each room sufficient direct radiation to warm the room independent of any heat carried in by the air supply.

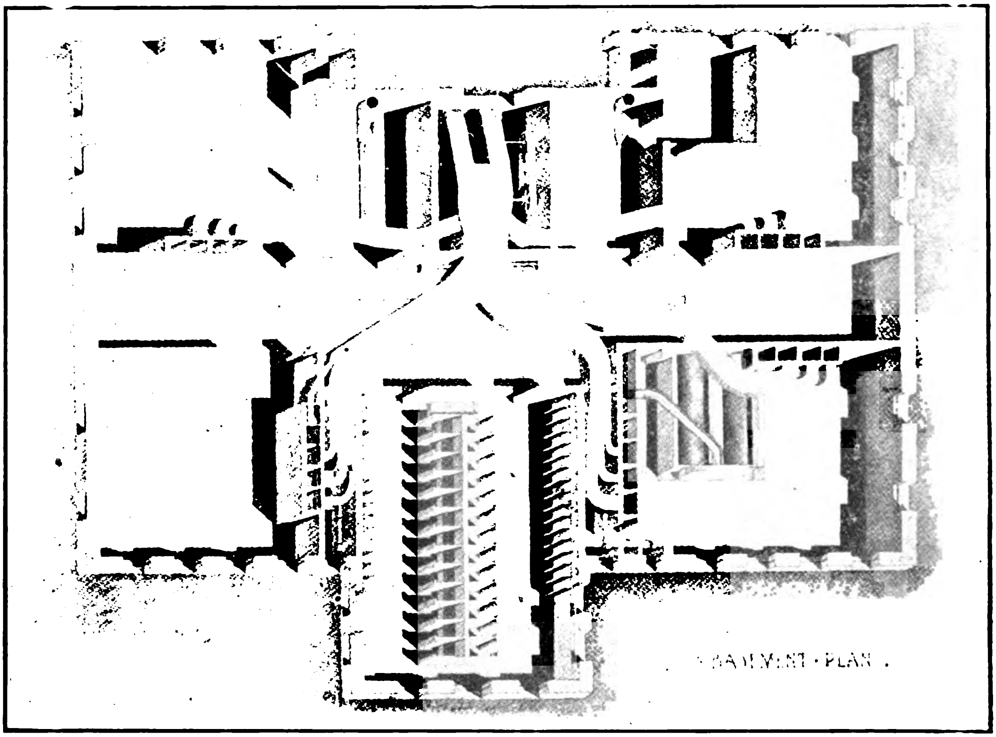

FIG. 4.

This illustrates the trunk line duct system, using direct radiators in each room for heating. Air at one temperature, about 70° F. is delivered for ventilation to all of the rooms. The room temperatures are controlled by admitting steam to or closing off the various radiators. Proper temperature regulation of buildings arranged in this way is rather difficult.

The combination of some local heat with the indirect system of ventilation gives the best results so far as practical operation is concerned, particularly in large buildings, though there is objection to the radiators, due to useful space occupied, local overheating, poor appearance, and improper air distribution.

CONDITIONS TO BE MET IN VENTILATION.

The delivery of a given volume of air does not in itself constitute ventilation. The air must not only be in the proper volume, but it must be conditioned as to temperature, moisture, cleanlines, etc., and then must be delivered so that each occupant of each room receives his share of it. Proper ventilation cannot be said to have been achieved even by the constant delivery of the proper amount of cleaned air to each occupant, at any given temperature and humidity, since very elaborate experiments as well as common sense indicate that our bodies and minds respond favorably to the stimulus of occasional sharp changes.

Some studies of this subject have seemed to indicate, for instance, that despite the serious objections to open-window ventilation, the average results as expressed in the effect on a large number of pupils, are superior to those obtained by the ordinary mechanical ventilating system, arranged with an unvarying temperature, a very low moisture content, constantly closed windows, and probably defective distribution of the fresh air.

So far, we have indicated that all the studies of ventilation that have been made are inconclusive, and we believe that no conclusive results can be obtained in the near future. The art is so young, the conditons affecting it are so obscure, and the response of the body is so involved with other factors, such as food, clothing, home conditions, predisposition to disease, etc., that we must move slowly and carefully and advance perhaps by a process of elimination.

We have, we believe, found that a school-room ventilating system will be favorable if the following conditions are fulfilled:

1. The room shall not be allowed to get warmer than 70° F. dry bulb, and 50° F. wet bulb.
2. The windows may be opened to the heart's content of the occupants.
3. No occupant shall be subjected unduly to direct radiant heat—that is, no one shall be compelled to sit closer to a radiator than, say, six feet.
4. No occupant shall be compelled to sit in an uncomfortable draft, caused by either air movement or great temperature difference.
5. The floor and the furniture shall have been warmed prior to occupancy to, say, within eight or ten degrees of the desired room temperature.
6. The entering fresh air shall be warmed by heaters or by dilution with the room air, or in some other way, to such an extent as to render its introduction a reasonably comfortable procedure, and this air shall be provided regardless of outside conditions, in proportion to the number of occupants of the room.
7. The air in its normal passage through the room shall sweep every portion of the same, and a lively air movement, say, thirty feet per minute, at and below the breathing zone, is desirable.

ARRANGEMENT OF SCHOOLHOUSE HEATING AND VENTILATING PLANT.

The following are some observations concerning the schoolhouse heating and ventilating plant as applied to the whole building rather than to class-rooms in particular:

A. The toilet rooms should have separate exhaust ventilation, so that a lower pressure is always maintained in these rooms, causing a constant air movement into the toilet rooms from the building, and never out of them into the building. The ventilation of the toilet rooms should be independent of the heating system, or of the outside temperature.

B. Chemical laboratories and other similar sources of contamination should have independent exhaust arrangements, and since the chemical exhausters are often required to handle products heavier than air, they should be localized for laboratory ventilation only and never combined with other functions.

C. The plan of the building should be such that there is no possibility of the air supply to the room entering the same after passing over the contents of the cloak-rooms or wardrobes, not because it has been proven that any particular contamination results therefrom, but because well-defined odors do originate there, which it is more pleasant, at least, to avoid.

D. With all deference to and appreciation of the observations which have been made of results on the physical and mental condition of the occupants of rooms having skillfully manipulated windows, without any other ventilating apparatus, we believe in the necessity of some scheme of air renewal and movement which shall be reasonably independent of the human element and of outside conditions. With full appreciation of the desirability of change and cold shock for hardening and toning up the body, we are fully convinced that the ordinary school faculty is unable judiciously and consistently to provide such conditions. Furthermore, with mild weather, no wind or heavy precipitation in effect outside, even the most skillful arranging of windows will fail to create adequate air movement. Any person who has experienced the well-known musty and stale odor which persists in school buildings having only window ventilation, will, we believe, subscribe to the necessity for a better condition. Therefore, mechanical ventilation, with full license as to window opening, is at present our best recourse.

E. With mechanical ventilation the source of power should be very reliable and as low in cost as practicable. Electric current from public utility plants is a convenient power, though subject to interruption from sleet storms, and usually costing several dollars per day for even medium-sized installations. Because steam usually is used for heating, steam power is nearly always the cheapest and most reliable for running fans. With steam as the heating medium, it is simple and economical to provide for air moistening, for hot water heating for showers, pools, etc., and to get very rapid results by using a vacuum system of steam circulation. With steam, the most distant and exposed rooms may be heated as thoroughly and quickly as the nearest rooms, and the toilets and offices may be kept warm at low cost without heating the class-rooms. A comparatively low steam pressure can be maintained; there is no danger from the boilers; and while a licensed engineer is highly desirable, his services will cost no more than those of any other equally competent custodian. With a medium pressure boiler plant, the cheapest coal can be burned without objectionable smoke. While it may be inconvenient it is entirely practicable to operate the fan for ventilation without heating the air at all. Experience, however, indicates that when no heat is necessary, the better ventilation usually may be obtained by opening wide all the windows.

F. It is probable that in a state of nature we would be compelled to live in a tropical or nearly tropical climate. We have, by the aid of artificial heating, learned how to live in temperate and even in arctic conditions. Our heating arrangements must be capable of keeping us reasonably comfortable in the very coldest weather. While there are physical sacrifices we must make for the sake of having these artificial heating plants and the housing that must accompany them, these sacrifices are as nothing compared wih the suffering, illness and mortality we should encounter if we were deprived of artificial heat altogether. Our heating apparatus is powerful enough for the coldest weather, although we have coldest weather only a few days and have great variation in outside temperature nearly every day. Therefore, most of the time the heating apparatus, unless consistently checked, will cause overheating, and a little overheating is far more harmful to us than a little underheating.

Teachers are valuable first, we believe, for their concentration to the work in hand, of observing, guiding and correcting the mental processes of the pupils. Teachers are notoriously incompetent when it comes to preventing overheating or under-heating or to manipulating ventilation. While they remain in the rooms, their normal senses cannot possibly react quickly to conditions there. Very material losses in fuel are occasioned by overheating, as well as losses in efficiency and losses in resistance to disease by the pupils.

Because of these losses and the failure of any other means of preventing them, there has been developed a very efficient system of automatic prevention of overheating, which is called automatic temperature regulation. It cannot cause a deficient or arbitrarily-controlled heating plant to furnish more heat, but it does draw the line at any reasonably set maximum temperature.

In connection with the temperature regulation, we have also a device which automatically will turn off or on the means of air moistening as the relative humidity encroaches upon certain limits either way.

Also, we can use the compressed air which is the motive power of the temperature controlling plant as a very efficient and satisfactory medium for remote damper and valve control. Such remote control is highly desirable, as for closing off ventilation when the building is unoccupied; for shutting-off certain departments as for night school; for stopping ventilation of an assembly hall when the room is not needed, etc.

(In next month's issue Mr. Lewis will illustrate and describe a typical school-house heating and ventilating system in which are embodied many of the suggestions contained in the foregoing discussion.)

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Sizing Ducts and Flues by Method No. 6.

In connection with Standard Data Sheet No. 10-T, published in this issue, and describing the sizing method for ducts and flues used by the Buffalo Forge Company (Method No. 6), the Buffalo Forge Company states:

"This method, which is explained quite elaborately, may seem clumsy, but if so it is only because we go into so much detail in explaining it, for in actual operation it is very simple and insures excellent results.

"We might add that in most installations we reduce friction by enlarging the area of the ducts so as to decrease the velocity gradually from the fan outlet to the end of the main duct, and this diverging nozzle effect gives a regain due to the transformation from velocity head into static pressure. This regain adds to the effective head, and thereby makes it possible to reduce the speed and horsepower of the fan as compared with what would otherwise be necessary. We have found by experiments that the amount thus added to the effective head corresponds to two-thirds of the difference between the velocity head at the fan outlet and the velocity head at the 5-in. straight section of main duct. For example: Suppose that we have a velocity of 2533 ft. at the fan outlet corresponding to 0.4 in. water gauge, and that this velocity is reduced at the end of the straight run of ducts to 1800 ft. per minute corresponding to approximately 0.2 in. water gauge, there will be a regain of two-thirds of this difference or about 0.13 in. This is sometimes an important item and while not properly a part of the method of designing ducts, it should be taken into consideration in arriving at the total frictional resistance of the system.

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A. S. ARMAGNAC....................*President*
GUSTAVE PETERSEN....*Secretary and Treasurer*

A. S. ARMAGNAC, Editor
GUSTAVE PETERSEN, Business Manager
HAROLD L. ALT, Contributing Editor

European Representative:
W. G. HOLLINWORTH, 304 High Holborn
London, W. C.

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WHATEVER effect the war may have on other industries, it is evident that the Government's programme for the inspection and possible rehabilitation of heating and power plants will create a market that will tax the resources of the manufacturers in this field to the utmost. Many of the supplies needed will come within the preferential Government list, so that the trade, as a whole, will have nothing to fear in the way of embargoes.

The principal cause of this remarkable state of affairs lies in the drastic action taken by the United States Fuel Administration regarding the supply of coal to power plants throughout the country. As has been announced in these columns, the supply will be limited and plants shown to be wasteful due to inefficient equipment or improper operation will be driven to more economical measures or have their fuel supply cut off altogether. The personal inspection, which is being conducted under Government auspices, specifically includes plants in office buildings, hotels, and apartment houses, so that the campaign is far from being limited strictly to power plants. By the time the inspection of each plant is completed, if not before, the need of at least some new equipment will no doubt be demonstrated. In fact, the Fuel Administration is figuring on a movement to improve the plants, if necessary, so that they may be rated in a high class by the time the inspector calls.

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DURING recent years we have heard on all sides the slogan of "Fuel Conservation." The gospel of smokeless combustion has been preached far and wide, and burners of coal, from the power plant operator to the householder, have been deluged with rules and suggestions for getting the last heat unit out of his fuel. It is true that the power plants, in no small measure, have heeded the call, but as much cannot be said of the average householder.

But now, how different the situation! According to announcements of the Fuel Administration we are about to be told how much coal we may burn during the heating season and we may rest assured that it will be the minimum of our requirements.

Every user of coal, therefore, in the country is interested in ways and means of reducing his coal consumption and, consequently, in improved apparatus and appliances that will accomplish that end. It has been the custom of The Heating and Ventilating Magazine for several years to make the October issue a "Smokeless Boiler Number." In view of the new situation this year's number will be known as a "Fuel Economy Number" and will appear in September in time to be of service before the opening of the heating season.

Mechanical Engineers' Symposium on Fuel Conservation

Although the fuel session, at the recent Worcester meeting of The American Society of Mechanical Engineers, was all too short for the discussion of the various topics listed, the full discussions, both verbal and written, have since been published in the society's *Journal,* forming Part 2 of the July issue. The discussion started with a presentation of the government's plan for fuel conservation, by David Moffat Myers, advisory engineer of the United States Fuel Administration. At present, he said, the Fuel Engineering Division is devoting itself exclusively to the work of conservation of fuel in stationary power plants, and in the efficient use of steam after its generation. The railway department is already working under a plan of organization devised by Major C. Schmidt, U. S. R., which Mr. Myers characterized as the work of a master mind.

The organization covering the stationary power plants comprises the central office at Washington, with an administrative engineer appointed in each coal-using State, attached to the Federal Fuel Administration of that State. The Administrative engineer has a consulting board of competent engineers and a staff of technical and clerical assistants and inspectors.

The plan of organization involves centralization on essential fundamentals only. These are uniform for all States. All other features are localized and extremely elastic in their numerous ramifications. This adopted principle renders the plan workable and effective under widely varying local conditions and circumstances.

The fundamentals of the national program are as follows:

- Personal inspection of every power plant.
- Rating and classification of every power plant in the country, in five classes, depending upon the thoroughness with which the owner conforms to the recommendations of the U. S. Fuel Administration.
- At the discretion of the Federal Fuel Administration, the supply of coal to any needlessly wasteful plant may be curtailed or stopped.

The plan is now in operation in Pennsylvania, the largest coal-consuming state, and also in Connecticut. Other States which have come in but in which the administrative engineer is not yet appointed, are Massachusetts, New York, New Jersey, Illinois, Michigan, Wisconsin, Indiana and Missouri.

STANDARD RECOMMENDATIONS OF FUEL ADMINISTRATION.

The standard recommendations of the United States Fuel Administration are substantially as follows:

- *Fuel.* That means be provided for measuring and recording fuel used each shift or day.
- *Water.* That boiler feedwater be heated ing surfaces be kept clean inside and out. by exhaust steam or waste heat, and measured.
- *Air Supply.* That a correct amount of air be supplied to the fuel, and that proper means be provided for measuring and regulating the draft.
- *Clean Heating Surfaces.* That boiler heating surfaces be kept clean inside and out.
- *Boiler and Furnace Settings.* That the furnace and setting be kept in good repair, and free from air leakage.
- *Insulation.* That exposed steam surfaces wasting heat by radiation be covered with suitable insulating material.
- *Engine-Room and Heating System.* That wherever possible, exhaust steam be utilized to the exclusion of direct steam from the boilers. (The plant should be designed and operated to produce no more exhaust than can be efficiently utilized in heating and process work.)
- *Supervision.* (1) That a competent employee or committee be detailed to supervise the work of fuel conservation in the boiler and engine plants; and (2) that a competent committee be appointed in charge of the work of fuel conservation in the buildings and shops outside of the power plants.

To assist in this work, the United States Fuel Administration has prepared a fifty-minute film of moving pictures, showing good and bad operation in the steam-boiler plant, methods of testing boilers, fuels, etc. These pictures will be available to each State, in connection with their publicity and educational propaganda.

The fuel administration is also preparing a series of official bulletins on engineering phases of steam and fuel economics. Some of these are now in press. They will include: Boiler and Furnace Testing; Flue-Gas Analysis; Saving Steam in Heating Systems; Boiler-Room Accounting Systems; Saving Steam and Fuel in Industrial Plants; Burning Fine Sizes of Anthracite; Boiler-Water

Treatment; Oil Burning; and Stoker Operation.

In addition to this service, a list of competent engineers has been prepared in Washington for each State, and is available for use of the local administration. As the work develops, still further constructive assistance is contemplated for helping owners to bring their plants up to a high plane of economy.

LIMITING COAL IMPURITIES IN PENNSYLVANIA.

On this subject a striking address was delivered by E. L. Cole, secretary of the Conservation Division of the Federal Fuel Administration of Pennsylvania, in which he told how the amount of impurities in anthracite and bituminous coal increased during the winter months of 1917, in spite of friendly suggestions made to operators. The fuel administration then formulated rulings limiting the percentage of slate, bone and under sizes that would be permitted by the Government in all sizes of anthracite. Inspectors were appointed to condemn all coal in a given section found below standard. Mr. Cole said a vast improvement has resulted, the May returns showing that less than one-half of 1% of the daily anthracite production of more than 250,000 tons was condemned by the Federal inspectors. This coal was condemned at the mines and reprepared for delivery.

It is the observation of the Fuel Administration, he said, that steam sizes of anthracite containing 40% of impurities are so inefficient in generating steam that the cost of such fuel is commercially prohibitory.

FUEL-OIL SITUATION

The fuel-oil situation was presented by President Alfred C. Bedford of the Standard Oil Company of New Jersey who said that he wished to plead for special economy in the use of fuel-oil and for its use only where, from the nature of the work, coal cannot properly be used. He said he did not care to be thought an alarmist, but when the needs of the navy are considered, together with those oil-burning cargo ships, it was easy to see that our consumption will be, as it was in 1917, in excess of our production. He said factories in the East must be asked to burn less fuel oil on account of the difficulty of transporting it from the Mexican oil fields. Particularly, fuel oil, he said, should not be used under steam boilers, either stationary or locomotive.

The symposium itself took up, among other things, "What is essential to the economical operation of hand-fired boiler furnaces when using soft coal?" "What experience have you had in the use of wood as fuel? To what extent is wood available as a fuel?" "What coal economies can be effected in residence heating?" and "What coal economies can be effected in small steam plants?" and, under miscellaneous, "School Heating, Insulation and Smoke Prevention."

COAL ECONOMIES IN RESIDENCE HEATING

Frank T. Chapman, who spoke on this topic, said: According to good authority approximately 120,000,000 tons (2000 lbs.) of coal is the present rate of use per year for domestic purposes in the United States. No accurate record exists to indicate what proportion of this coal is used for residence-heating purposes, but probably at least two-thirds, or 80,000,000 tons, of this amount is used for what might be broadly stated as residence heating.

The possible saving in coal used for residence heating may be divided into five principal items as follows:

1 Elimination of Heating for Unnecessary Rooms and Buildings:
  a Shutting heat off from rooms not actually needed.
  b Closing of large residences where heating requirement is unreasonable for number of occupants or the re-arrangement of heating equipment in order to heat only the portion of house actually needed for occupancy. (This item should represent a saving of at least 10%.)
2 Lower Temperature Maintained in Homes:
  a A 5° lower average than past practice would save about 10% of the fuel requirement.
3 Observance of Practical Methods of Reducing Preventable Heat Losses:
  a Insulation of cellar piping, heater or other sources of heat loss.
  b Prevention of undue leakage at windows and doors.
4 Economical Operation of Heating Apparatus:
  a The keeping of gas passages of heaters clean. (By far the most vital factor and the most important to emphasize.)
  b Proper draft regulation.
  c Sifting ashes where they contain fuel value.
  d The study and application of available war coal-saving rules. (This item No. 4 should represent a possible saving of 20%.)
5 The Use Where Available of Substitutes for Coal as Fuel, such as natural gas, kerosene oil, fuel oil, wood, peat.

A summary of these possible savings totals a proportion of about 50% of the coal now used for residence heating. For practical calculation let us assume that one-half this proportion, or 25% of the saving, can actually be effected, provided proper means are used to inspire, educate and require the public to take a more personal interest in conserving coal. Based upon 80,000,000 tons, 25% would mean a saving of 20,000,000 tons in residence-heating work, to which could undoubtedly be added a goodly percentage of coal now used for domestic cooking and hot-water service, by increased economy in its use and by a more extensive substitution of other fuels for cooking.

The practical possible saving on all domestic uses of coal would, therefore, appear to lie somewhere between 20,000,000 and 30,000,000 tons. It is important to note that in this 25% saving, only 10% is figured as secured from "economy of operation," the remainder being mainly by elimination and lower maintained temperatures.

Having visualized the first two phases of the subject question, we come to the third phase, viz., the method of procedure that will bring about the greatest conservation. This phase is only indirectly covered by the original subject, but is the vital factor which governs the proportion of the possible economies that can be effected.

An active educational program with punch and compulsion in it, as well as an appeal to patriotism, is required, and such a program must necessarily be based upon a plan of regulation and limitation of coal supply calculated upon quantities requiring economy. Only by such means can the average householder be aroused and impressed with the fact that if he does not study and apply the conservation rules, his negligence will react upon the comfort of his own family. He will run short of coal, while his neighbor who has observed the rules will have sufficient for his needs.

Information accumulated leads to the statement that a sufficiently consistent plan of apportioning coal for residence heating, cooking and hot-water service by regulation and limitation, can be secured in making the enforcement practical.

COST OF SCHOOL HEATING.

J. H. Brady, chief engineer and superintendent of buildings for the School District of Kansas City contributed a report made by him to the Board of Directors of the School District of Kansas City, Mo. This report is given in great detail and is extremely valuable. It contains a tabulated statement for 1916-17, showing the cost per cubic foot for heating the buildings of the school district.

There are 88 public buildings having a total cubic contents of 32,300,000 cu. ft. and an average per building of 367,000 cu. ft. More than half the buildings contain over 250,000 cu. ft. of space and several are much larger. The cost of fuel for all the buildings averaged 3.1 mills per cubic foot. The figures given in the report include the fuel furnished the custodians of the buildings for their residences, except in the case of seven buildings. In what follows is a brief summary of the conclusions:

Grouping the buildings accordings to the type of heating plant used gives the following results:

Group No. 1, steam hot blast, using fuel oil, average cost 3.5 mills per cubic foot.

Group No. 2, direct radiation, using fuel oil, average cost 3.6 mills per cubic foot.

Group No. 3, steam hot blast, using coal for fuel, average cost 2.8 mills per cubic foot.

Group No. 4, direct radiation, using coal, average cost 2.9 mills per cubic foot.

Group No. 5, frame and brick buildings heated by stoves, average cost 4.1 mills per cubic foot.

Group No. 6, schools heated by hot-air furnaces, using coal, average cost 3.6 mills per cubic foot.

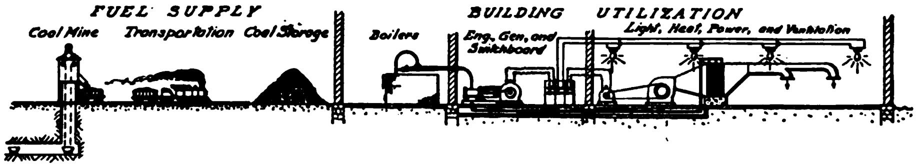
Contrasting two of the buildings, the writer states:

"Central High School shows a cost of 2.7 mills per cubic foot while Northeast shows a cost of 2.5 mills per cubic foot. The cubic contents of Northeast High is greater than Central High, and the difference in the cost per cubic feet for heating the two buildings is, in my opinion, due to the fact that Central High has metal frames and sash while Northeast has wooden frames and sash, and the leakage of air or wind around metal sash is greater than with wooden sash. Both these buildings use coal for fuel. As a rule the high cost of heating certain buildings is caused by metal frames and sash, while in other buildings it is due to poor construction, taking into account their age, etc."

Another point is the fact that where mechanical ventilation, or what is known as hot blast fan system, using coal for fuel, is installed, the cost for heating per cubic foot, is less on an average than the others, being 2.8 mills.

The fact that the figures for schools equipped with mechanical ventilation run less than for those not so equipped may be attributed to automatic temperature control. The highest cost per cu. ft. is shown where stoves are used for heating, being 4.1 mills.

POWER PLANT ENGINEERING



Steam Turbines for Building Power Plants

It is remarkable that, with its inherent advantages, its simplicity, and its clean exhaust steam, the steam turbine has not been more largely used in the building power plant. Probably the chief causes is the comparative newness of the development of small-size turbines, the fact that the manufacturers of such machines are still limited in number and that it is easier to secure operating engineers for simple and even Corliss engines than it is to secure one for steam turbines. To the operating man the turbine seems to have given a general impression of mystery from which he assumes its operation to be complicated, its parts incomprehensible and he, therefore, feels more helpless and has much less self-confidence when asked to run a turbine than when a plain engine proposition is placed before him.

Now what are the facts of the case? Is the turbine more complicated and is it more difficult to operate than an engine? Is it harder to repair and are its repairs and adjustments required more frequently than the simpler types of engines or are they not?

Of course, the reader is familiar with the principle of turbine operation, viz., the shooting of jets of steam against the recesses on the side or circumference of the rotor which is thus "blown" around, as one might say, by the force of the steam impinging on these recesses. The old mill wheel with its paddles set in a swiftly-running stream is an example of this; the side wheel and stern wheel steamboats are another,—but with the action reversed—(in this case the wheel moves the water by the power supplied from the engine instead of the water moving the wheel and furnishing power *to* the engine).

The actual wheel as employed in the Terry steam turbine is shown in Fig. 1 and the action of the steam on the wheel is illustrated in Fig. 2. Therefore, the apparatus consists simply of such a wheel—or several wheels—mounted on a shaft and against which the steam jets are directed from one or more nozzles. The turning of the wheel or wheels which are keyed onto the shaft of course turns the shaft which is connected to a generator, alternator, pump or other apparatus to be operated.

EARLY FAULTS OF CONSTRUCTION REMEDIED.

Formerly, these wheels were a weak feature of turbine construction, being arranged so that the clearance between the wheel and the casing was very small. An interference or *rubbing* between the wheel and the casing with this resulted from the slightest distortion of the shaft or temperature move-

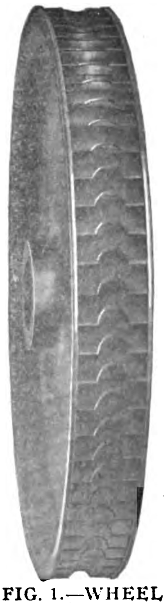


FIG. 1.—WHEEL OF TERRY STEAM TURBINE

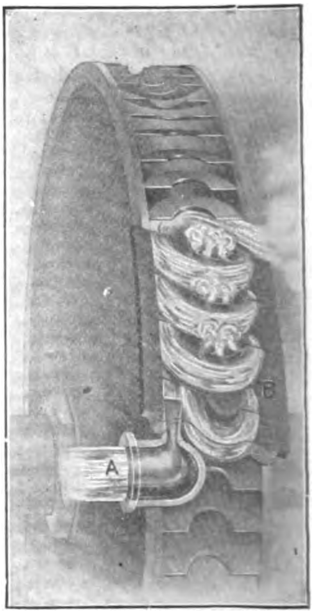


FIG. 2.—ACTION OF STEAM ON WHEEL.

ment of the casing. The buckets were also arranged so that any such interference would be almost sure to injure them beyond repair, making a replacement necessary. With the present turbine models this danger is eliminated, first, by using larger clearances—sometimes 1½ in. or so—and, second, by building the wheel so that rubbing on the sides or circumference comes on a projecting ring, thus protecting the buckets which are set slightly inside the protecting ring. Having eliminated all danger of smashed or damaged buckets no further worry need be felt on this score but how about the adjustment?

If the expansion and contraction of the casing due to heating and cooling by the steam, or by the twisting of the supply and exhaust pipes connected thereto takes place to any reasonably slight degree there is more than enough clearness to prevent any serious interference from this cause; so this objection is also eliminated. With these two features properly taken care of in the design there is nothing else to cause trouble as this casing and wheel described *constitute* the turbine as is indicated in the interior view of a Terry steam turbine of which a cross section is shown in Fig. 3.

CLEAN EXHAUST STEAM SECURED WITH TURBINES

If it is assumed—as may safely be done—that the steam turbine as a mechanical machine is beyond reasonable criticism, what other merits has it to recommend it for small building power plants? Probably the most unusual feature is the clean exhaust received from such machines. Referring to Fig. 3, it will be noted that there is no need, or even opportunity, to apply oil to the interior, the only oiled surfaces being the two main bearings outside the casing. This not only results in clean exhaust without oil but at the same time eliminates the use of oil separators, grease traps and greasy drips. A further gain is made in the quantity of oil used.

SMALL SPACE REQUIRED

A second great advantage is *space*. A steam turbine can be set up in a fraction of the space required for an engine of equal capacity. To realize the tremendous difference it is only necessary to refer to Fig. 4 where the comparative plans and elevation of a 100-H.P. engine and a 100-H. P. turbine are shown, both drawn to the same scale. More than that, the space for drawing pistons is not needed in a turbine, in fact, besides the necessary access aisle around the machine no other space is necessary for dismantling. The smallness and compactness of such an outfit is further illustrated by Fig. 5 which is a Sturtevant turbine direct-connected to a D. C. generator.

DEPENDABLE SERVICE FOR LONG PERIODS

After setting up and starting a turbine no further attention except oiling is required until the bearings wear out and need to be re-lined. There is no matter of adjustment to be constantly kept in condition and no

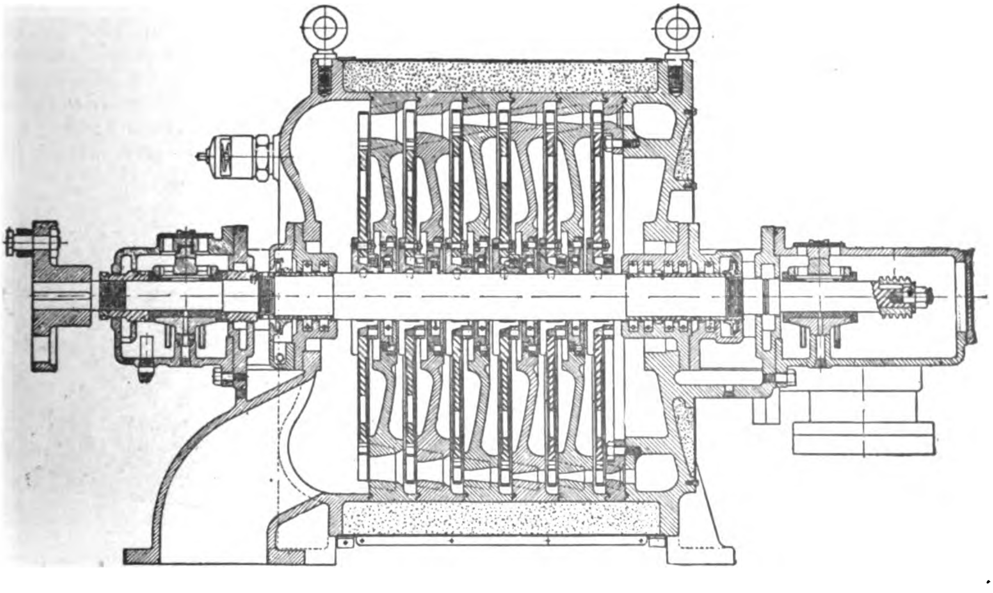


FIG. 3.—CROSS SECTION OF TERRY STEAM TURBINE.

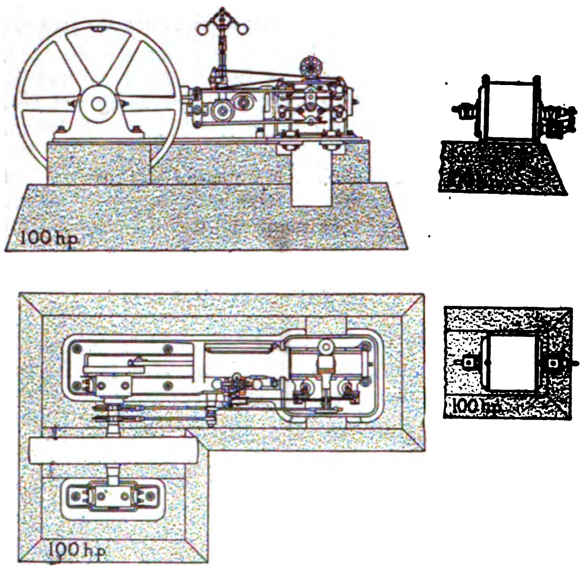


FIG. 4.—COMPARATIVE PLAN AND ELEVATION OF A 100-H.P. ENGINE AND A 100-H. P. TURBINE.

loss of efficiency is possible through an incorrect setting of valves or cut-off. Turbines tested after years of hard service have shown practically the same steam consumption and the same economies as when installed.

The long periods during which these machines will give constant and dependable service renders them particularly suitable for building power-plant service. The writer was recently in a small plant supplying light and power to four or five little isolated buildings where a small turbine had been started six months previously and had been running night and day every minute since. According to all indications it might easily be many more periods of six months before anything would require its stoppage.

Now as to regulation—are these machines capable to close speed regulation such as is necessary for generators and alternators supplying current for lighting to avoid flickering of the lamps? In regard to this it might be said that the turbine is capable of just as close regulation as an engine, the speed variation under practical test on a 125 Kw. machine being 1.17% from no load to full load, and it may always be kept within 3% of normal from no load to full load on small machines and within 2% on larger units. Closer regulation may be obtained if desired.

It must not be assumed that the small turbine has not already been used in building power-plants for many buildings although, of course, they by no means are as numerous nor in as common use as the well-known steam engine of various types.

Fig. 7 shows a view of two Terry turbines of 50, and 125-Kw. capacity, respectively, and one General Electric Co. 75-Kw. turbine installed in a Hartford, Conn., department store.

OPERATION UNDER PARTIAL LOADS

Still another advantage which can be obtained with steam turbines of some types where nozzles are used in higher efficiencies under partial loads. For instance with a four-nozzle machine, with 20% of the full load, only one nozzle is used; with 40% or 50%, two nozzles, etc. A curve plotted to show the economy so obtained is shown in Fig. 6. Here the consumption at full load is shown starting off and increasing as indicated by the dotted line. But the gradual closing of the five out of six nozzles as the load falls off keeps the steam consumption down to the levels indicated by the heavy lines.

FOUNDATIONS LIGHTER THAN FOR RECIPROCATING ENGINES

In spite of the very high speeds obtained in steam turbines (running from 3600 R. P. M. downward) the foundations required are much lighter than for reciprocating engines of similar capacity. This is because in the turning of the rotor it finds its own center and maintains its own stability, not being subject to shocks caused by the sudden change in the movement of large masses of

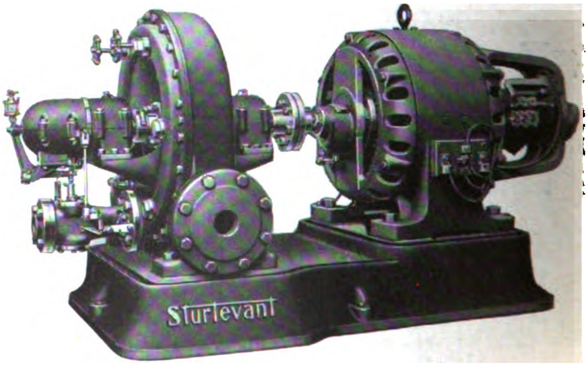


FIG. 5.—STURTEVANT TURBINE DIRECT-CONNECTED TO A D. C. GENERATOR

metal as is the case with an engine. Under these higher speeds a smaller and, therefore, a less expensive electric machine can be used as it is well known that a generator will produce more power at a higher speed.

One of the chief items of expense in a small power-plant are the large slow-speed generators it is necessary to use for direct engine connection whereas with turbines the electric manufacturers have been hard pressed in some cases to produce an electric machine that will stand up under the direct drive of higher speed turbines.

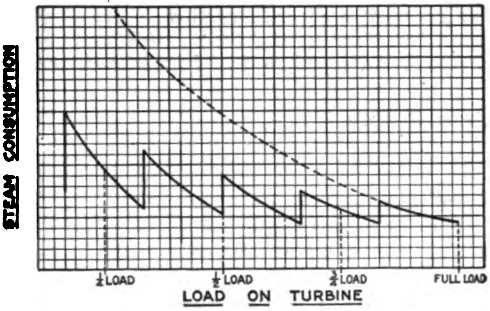


FIG. 6.—ECONOMY CURVE

There are other items in the power plant besides the main units, however, which can profitably utilize turbine drives in preference to electric motors. Turbine-driven forced-draft fans, turbine-driven boiler-feed pumps, and turbine-driven circulating pumps are becoming more and more common and, compared to the electric motor, their efficiency is much higher as their exhaust can be turned directly into the feed-water heater or steam heating system.

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An Hour's Study per Day Proposed for Technical Men.

The question is raised by a writer in the American Association of Engineers' Journal whether it is not advisable for every employer or manager of technical men to require them to read and study, say, an average of six solid hours weekly and the opinion is expressed that such a procedure would repay the employer richly, even if the entire six hours of study were at the employer's expense.

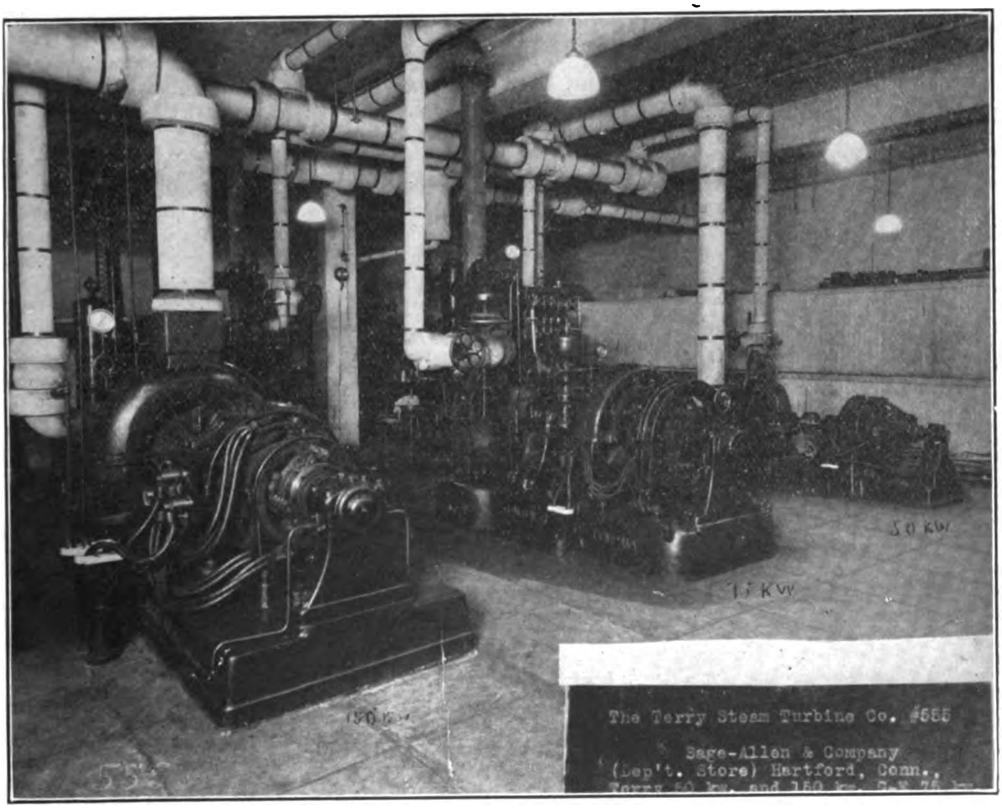
50 KW
75 KW
150 KW
555
The Terry Steam Turbine Co. #555
Sage-Allen & Company
(Dep't. Store) Hartford, Conn.,
Terry 50 kw. and 150 kw.

FIG. 7.—STEAM TURBINE INSTALLATION IN HARTFORD (CONN.) DEPARTMENT STORE.

Modern Practice In Vapor Heating

EDITOR'S NOTE—*For the purpose of this series of articles, a vapor, vacuum, vapor-vacuum, vacuum-vapor, atmospheric, modulated or themograde system of heating will be considered as any system in which the steam pressure ordinarily carried is practically at atmosphere or slightly below or in which the returns are open to the atmosphere and where no pump or other positive mechanical device is employed to pull back the returns.*

II.—THE HUTCHISON SYSTEM.

The next patented system to be considered on this series is that of the Hutchison system of vapor heating, manufactured by the Hutchison Vapor Heating Corporation, Washington, D. C. which possesses some features in common with the Adsco system described in a previous issue. This resemblance extends to a modulating valve on the supply end of each radiator and a union elbow on the return connection which, in turn, involves the use of an excess of radiation to avoid vapor getting into the return lines. The chief points of difference lie in the "trap receiver" and "damper regulator" employed.

The chief requirements consist of such items as

A graduating valve on the supply end of each radiator and a union elbow on the return end.

A special trap receiver on the return, a special regulator to control the drafts, a special safety valve and an air vent to relieve the air.

Additional radiation of 20% on each radiator in order to be sure of condensing all vapor in the radiator.

The piping required for this system is illustrated in Fig. 1 the steam (or vapor) being generated in the boiler and flowing out through the supply mains and risers to the graduating valves on the radiators.

In piping the steam main the riser from the boiler should be run up full size of tapping and should be reduced at the first elbow or tee to the proper size. The main may be run by the circuit method, starting high at the boiler and, running around the building, pitch constantly down until the main has returned to the boiler location at which point it is dripped by a bleeder connected into the boiler return below the water line. On larger systems the split main is used as illustrated.

If for any reason it is desirable to jump the main at any point all that is necessary is to carry the main pitching down to the point where the jump is to be made, take a bleeder off at this point (connected back to boiler under the water line) and raise the main as much as desired. This is illustrated in Fig. 2.

The grade of the mains should be made not less than 1 in. in 20 ft. where the steam and condensation flow in the same direction and 3 in. in 20 ft. where the condensation and steam flow in opposite directions.

The size of the steam mains is based on the length of run, square feet of radiation, and number of elbows in the line. Table I shows the proper sizes for various conditions, allowing 2 oz. loss in pressure from the boiler to the last radiator and in measuring up the length of run 10 ft. is added for each 90° elbow.

TABLE I

Nominal Size of Pipe In. Diam.	Length of Run of Main in Lineal Ft.			
	100 ft. or less	100-150 ft.	150-200 ft.	200-300 ft.
	Radiation in Square Feet.			
1¼	160	145	122	100
1½	265	210	190	150
2	520	450	380	310
2½	860	700	600	490
3	1500	1250	1070	900
3½	2200	1800	1550	1250
4	3300	2600	2200	1800
4½	4500	3700	3200	2600
5	6200	5000	4400	3600
6	....	8400	7200	5800

Where bleeders are installed the sizes should be as given in Table II.

TABLE II

Size of Main In. Diam.	Run of 0-150 Ft., In Diam.	Run of 150-300 Ft., In Diam.
1¼ and 1½	1	1
2 to 3	1	1¼
3½ to 6	1¼	1½

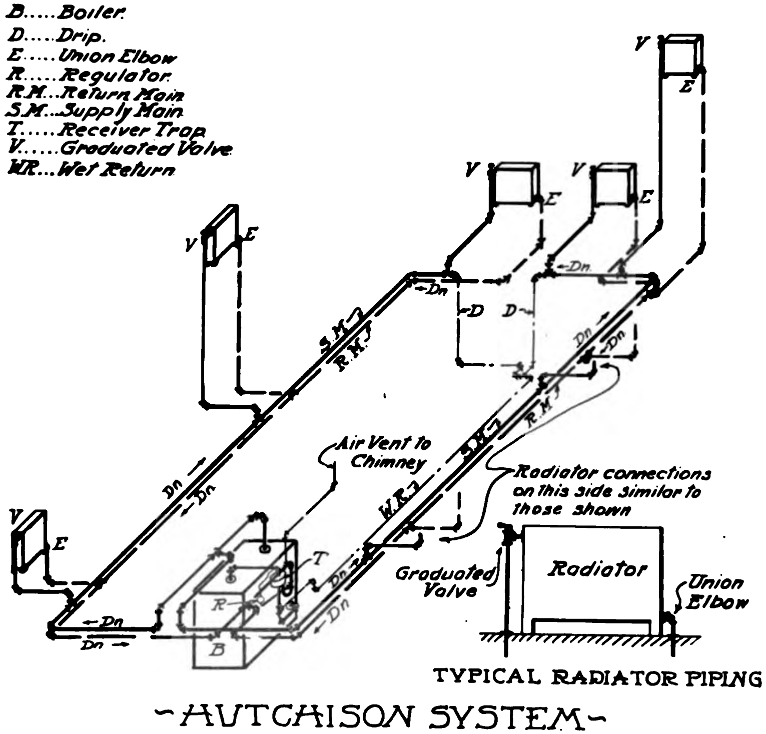

FIG. 1.—TYPICAL LAYOUT OF HUTCHISON SYSTEM.

with a maximum length of 1 in. bleeder pipe limited to 55 ft.

Where risers go to only one radiator on the second story the riser may be made the same size as the radiator branch, but when two or more radiators are supplied the size of the riser depends on its distance from the boiler as shown in Table III.

TABLE III

Nom. Size of Pipe In. Diam.	Distance from Boiler in Feet 100	150	200	300
	Square feet of radiation supplied.			
1	80	66	56	46
1¼	160	145	122	100
1½	265	210	190	150
2	520	450	380	310

Where the risers are higher or have numerous connections they should be sized on the same basis of the steam main using the distance from the top of the riser back to the boiler as the length of run and adding 10 ft. for each 90° elbow.

The graduating valve is of the packless type and opens and closes a port by the movement of a tapering slot attached to the valve spindle across the port opening as illustrated in the sectional cut, Fig. 3.

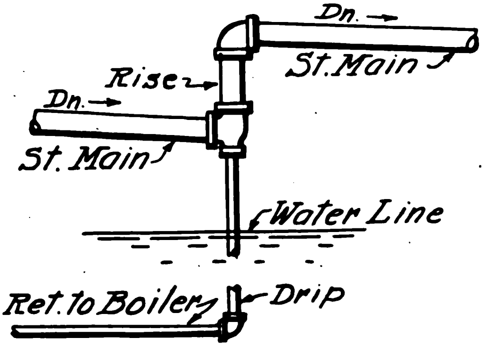

FIG. 2.—ARRANGEMENT FOR "JUMPING" THE MAIN.

The dimensions of this valve as indicated on the diagram, Fig. 4 are as follows:

Size of Valve Inches.	a Inches.	b Inches.
½	1¼	3
¾	1⅜	3
1	1⅞	3¼

The graduating supply valves are calibrated so that ½-in. valves are suitable to use on radiators of 30 sq. ft. or less; ¾-in. valves on 31 to 90 sq. ft. and 1-in. valves on radiators of 91 to 180 sq. ft.

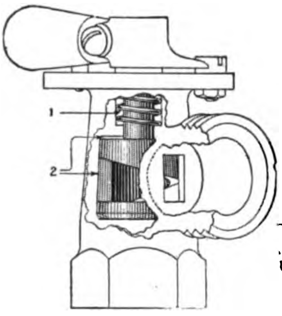

Fig. 3—Sectional View of Hutchison Packless Graduating Valve.

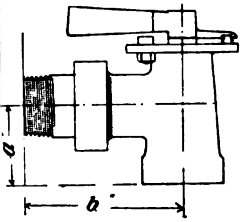

Fig. 4—Dimensions.

The radiators used should be of the water pipe tapped for top supply and bottom return, the return tapping being eccentric and either at the same or opposite end from the steam connection. Water radiators should never be tapped bottom supply. The size of the radiator tappings should be as indicated in Table IV.

TABLE IV.

Size of Radiator Square Feet.	Supply In. Diam.	Return In. Diam.
0-30	½	½
31-90	¾	½
91-180	1	½

The vapor being condensed in the radiator flows out along with the air through the union elbow on the return end and into the return mains which are vented to the atmosphere. The union elbow is shown in Fig. 5 and is made only in the ½-in. size, the dimensions being as indicated.

Continuing from the ½-in. return elbow (into which is screwed a ½-in. stub from which a ¾-in. horizontal pipe is used to connect to the riser) the return condensation and air follow down the return risers and mains back toward the boiler.

The returns are sized as shown in Table V.

TABLE V.

Nom. Size of Pipe. In. Diam.	Maximum Radiation Sq. Ft.	Maximum Hor. Length Feet.	Maximum Total Length Feet.
½	180	None	Stub
¾	500	25	100
1	900	40	100
1¼	1900	65	100
1½	3000	100	100
2	5200	125	125

Whenever it is necessary to exceed the length allowed in the above schedule the pipe is increased one size.

The condensation and air then return to the trap receiver, the air vent being connected just before the drop is made to the receiver. Here the regulator bulb is attached as illustrated in Fig. 6, the bulb consisting of a closed sphere connected by a flexible pipe to the trap receiver and by a small tube to the return line to serve as a relief pipe. Any increase of pressure in the boiler causes the water to back up from the trap receiver and flood the closed sphere; this so increases the weight of the sphere that it drops sufficiently to close the drafts by means of the chains to which the sphere is connected.

On the vapor pressure being reduced by the closing of the drafts the water flows out of the sphere and returns to the receiver through the flexible pipe thus reducing the sphere's weight and allowing the counter-spring to draw up the sphere together with its damper chains, thus again opening the drafts. The inlet and outlet of water from the sphere is made possible by means of a small flexible balance pipe previously mentioned as running from the top of the sphere to return pipe being connected thereto above the water line. This receiver also prevents the backing of water out of the boiler without the use of a check whenever any pressure is generated.

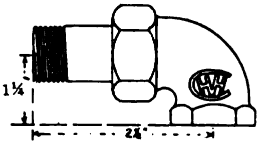

FIG. 5.—UNION ELBOW.

The size of the trap receiver should be No. 1¼ for boilers of 2500 sq. ft. or less and No. 2 for boilers of 2500 sq. ft. or over, these being tapped the same size as their respective numbers, while the damper regulator should be

No. 1¼ for boilers of 2500 sq. ft. or less and No. 2 for boilers of 2500 sq. ft. or over.

When radiators are located on the side walls only slightly above the water line the condensation may be returned direct to the boiler through a wet return provided the air is relieved back into the main return by a line which is not pocketed and which lies above the boiler water line throughout its entire length. Such wet returns should be sized as shown in Table VI.

TABLE VI.

Nom. Size of Pipe In. Diam.	Radiation Square Ft.	Maximum Length Ft.
1	1000	50
1¼	1800	75
1½	3600	125
2	6000	200

The vent line to the chimney is made as per Table VII.

TABLE VII

Nom. Size of Pipe In. Diam.	Boiler Capacity Square Feet Radiation
1	700 or less
1¼	700 to 1900
1½	1900 to 3000
2	3000 to 5000

The vent line must be carried up to a point at least 10 ft. above the level of the return line; this may be done either outside the chimney or inside the chimney. If the line is run inside it should be of galvanized iron pipe finished off at the top with a tee the vertical pipe entering the branch tapping so that the back of the tee will prevent the soot dropping down and clogging the vent. Plugs to permit cleaning out the vent line should be placed at all turns in the pipe.

The special safety valve is set at 8-oz. pressure and is of the pop, side-lever type, all parts being of brass except a malleable iron base. The various sizes of safety valve should be used on systems of the following capacity:

1-in. valve on 700 sq. ft. or less of radiation.
1¼-in. valve on 700 to 1200 sq. ft. or less of radiation.
1½-in. valve on 1200 to 2000 sq. ft. or less of radiation.
2-in. valve on 2000 to 3500 sq. ft. or less of radiation.

It is important to remember that all pipe sizes as herein listed are based on having the full area of the pipe and will not apply where pipes *are not reamed.* Where it is necessary to use an unusual number of fittings the pipe should be increased one size to reduce the friction as much as possible.

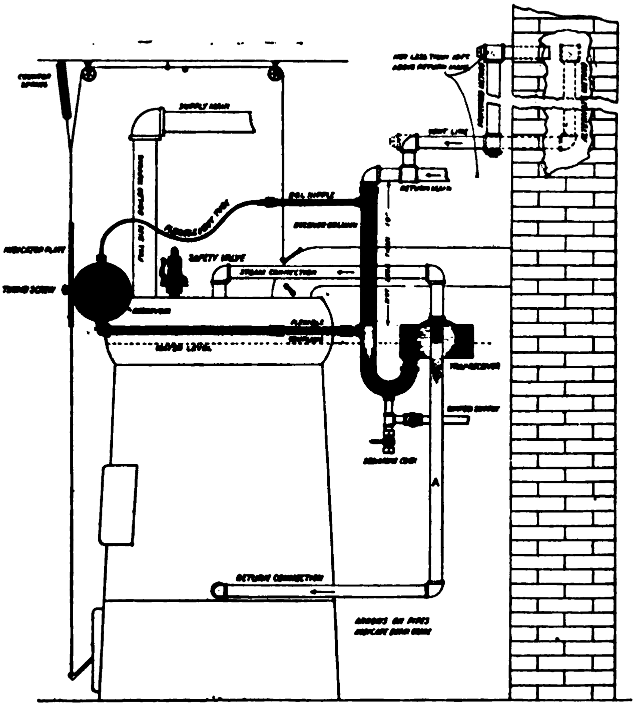

FIG. 6.—BOILER CONNECTIONS WITH HUTCHISON SYSTEM.

Wage Scales in the Building Trades.

Comparative figures showing how wages have advanced in every branch of construction during the past two years have been compiled for the Philadelphia district by the *Builders' Guide* of Philadelphia. The showing for the heating and allied trades is as follows:

Plumbers—1903, $4.25; 1904, $4.50; 1906, (February), $4.75; 1906, (Oct.), $5.00; 1910, $5.50; 1917 (July), $6.00. Agreement expires July 1, 1920.

Steam Fitters—1903, $4.50; 1906, $5.00; 1911, $5.50; 1917 (July), $6.00. Agreement expires Jan. 1, 1920.

Steam Fitters' Helpers—1903, $2.65; 1906, $3.00; 1917 (Apr.), $3.20; 1917 (July), $3.40. Agreement expires Jan. 1, 1920.

Roofers and Sheet Metal Workers—1903, $4.00; 1905, $4.50; 1910, $4.75; 1913, $5.00; 1918, $5.60.

The War and the Heating Engineer

Homes to Be Put on Fuel Rations.

According to an announcement of Harry A. Garfield United States Fuel Administrator, a rationing scheme has been drafted, based upon the so-called Philadelphia plan. In discussing the plan Mr. Garfield said:

"There will not be enough household coal available this winter if last year's waste continues or if unequal local distribution is not prevented.

"The fuel administration has taken the necessary steps to this end. Householders may be put on coal rations as in England and France. The coal allowed to each consumer will not be the amount used last year, but only so much as is scientifically found sufficient to heat his house to 68°, providing every conservation rule has been obeyed. The allowance for each will be sufficient for comfort, but the thoughtless and wasteful consumer who finds his allowance gone before the end of the winter will have only himself to thank if he has no fuel with which to heat his house.

"Under this system every one will get his fair proportion of coal. The hoarder will be eliminated. This system was originally worked out and applied in Philadelphia. It has proved an unqualified success and, with modifications suggested by the experiences in that city, the adoption and enforcement has been referred to the Federal fuel administration in all States.

CENSORSHIP OF ALL BINS.

"This plan involves a department of coal allotments in connection with each local fuel administrator's office. Plans for this organization and for the necessary equipment have been completed by the administration in Washington in such detail that the local bureaus can inaugurate the system without delay. The important features of the plan are:

"First, a censorship of every order for coal received by any dealer, each order being compared with a figure obtained by very simple yet effective formulas showing the rating of the house where the coal is to be used;

"Second, actual inspection of all doubtful cases and a checking up through inspectors of statements made by householders as to the coal on hand, the space to be heated and the heating system employed;

"Third, an effective refusal to furnish any householder more coal than a scientific analysis shows is necessary if the requisite care is taken in the heating of the house. Under this system surplus coal will be refused.

VIOLATORS TO BE PROSECUTED

"All consumers who have obtained a quantity of coal in excess of their allotments, or who by deceit or misrepresentations have violated any rules and regulations of the fuel administration, will be prosecuted."

The United States Fuel Administration has announced that allotment has been made to the State of New York of approximately 10% more anthracite coal this year, which should result in a substantial increase to each community and go far to avert the danger of a famine.

"With regard to the domestic situation in New York City," says the Fuel Administration, "you are advised that there is a steady movement of domestic anthracite now going into Greater New York, which is ahead of the previous year's shipments on a proportionate monthly basis. Distribution this year is following the lines of the coal year 1916-1917, or, in other words, the period from April 1, 1916, until March 31, 1917.

"During this period 7,160,344 tons of domestic sizes were shipped into Greater New York and 4,390,766 tons of No. 1 buckwheat or smaller sizes, which would mean an average monthly shipment of 596,695 tons of domestic.

"During April and May this year the figures are 1,225,524 domestic sizes and 699,998 smaller, or an average of 612.762 per month. Greater New York, on the basis of monthly shipments, is getting more domestic coal than formerly."

Coal-Distribution Plan.

In connection with the plans for the distribution of coal within the various States the War Industries Board will decide what consumers shall have preference in securing coal. but the United States Fuel Administration has been asked to assist in the compilation of complete preference lists.

The crux of the new distribution plan lies in the compilation of these preference lists. All consumers of coal, except domestic consumers, will be recorded under the following classifications: (a) Railroads; (b) Army and Navy, together with other departments of the Federal Government; (c) State and county departments and institutions; (d) public utilities; (e) retail dealers; (f) manufacturing plants on War Industries Board's Preference List; (g) manufacturing plants not on War Industries Board's Preference List. The first six classes will be given preference in coal shipments in cooperation with the plans of the War Industries Board.

The list of consumers entitled to preference as established by the War Industries Board will be obtained through a questionnaire sent to every manufacturing plant in the country using more than 500 tons of coal annually. This list when compiled, will be furnished to each Fuel Administration District Representative in the producing field which supply the various States, and with these lists to guide them, together with weekly reports which will be required from each manufacturing plant, the State and local fuel administrators and district representatives will give their particular attention to building up proper stocks of coal at all essential war plants.

Under this plan of distribution each consumer should arrange for shipments from the same source of supply as last year, if possible.

Reports Wanted on "Enemy" Property.

Those who have reports or information on enemy-owned property in their vicinity are asked to communicate the facts at once to the Bureau of Investigation, Alien Property Custodian, Washington, D. C. About $750,000,000 worth of property has already been reported to Washington, but the custodian, A. Mitchell Palmer, states that there is undoubtedly much more to be located.

Administrative Engineers for Fuel Administration.

The list of administration engineers appointed to date by the United States Fuel Administration are:

Thomas R. Brown, Pittsburgh, for western half of Pennsylvania; formerly special engineer of Westinghouse Air Brake Co.

George R. Henderson, Philadelphia, for eastern half of Pennsylvania; formerly consulting engineer of Baldwin Locomotive Works.

Edward N. Trump, New York City, for State of New York; vice-president of Solvay Process Company.

W. R. C. Corson, Hartford, for New England; secretary, Hartford Steam Boiler Insurance Co.

Charles A. Cahill, Milwaukee, for Wisconsin.

As already announced in these columns, the national plan of the fuel administration provides for:

1. Personal inspection of every power plant in the country.
2. Classification and rating of every power plant, based upon the thoroughness with which each owner of said plant conforms to recommendations.
3. Responsibility of rating the plants will fall upon the administrative engineer in each State, the rating to be based upon the reports of inspectors, who will not express opinions, but collect definite information. The State fuel administrator, in his judgment, may entirely or partially shut off the supply of coal to any needlessly wasteful plant in his territory.

Frank C. Wagner, professor of mechanical engineering at Rose Polytechnic Institute, Terre Haute, Ind., has been appointed administrative engineer for the United States Fuel Administration for Indiana. In addition, Professor Wagner and Charles Brossman, consulting engineer, of Indianapolis, have been appointed by the fuel administration to take charge of special fuel conservation activities in Indiana industries. Mr. Brossman's duties will be limited to investigation of electric power plants in the State for the purpose of making recommendations for the consolidation of certain plants in order to save fuel.

In Charge of Power Plant Efficiency.

The United States Fuel Administration has appointed Henderson W. Knott to manage the field force of engineers and inspectors which is at work among the power plants of the country, carrying out a campaign of instruction and inspection designed to bring the use of fuel for the production of power to the highest possible efficiency and economy. Mr. Knott has been the general manager of the Morgan Crucible Company of New York City.

The appointment of Mr. Knott is a part of the plan, originated by David Moffat Myers, advisory fuel engineer of the Fuel Administration, to have each of the 250,000 steam plants in the United States visited by a competent man who can make suggestions and report in connection with the questionnaire originated by Mr. Myers, working with committees from the four great engineering societies. This work will naturally require a large number of inspectors devoting their time to traveling among the steam plants.

This field force will be organized by States in order to give it greater force and efficiency. Many of the State heads who work directely under the State Fuel Administrators have already been appointed and Mr. Knott, co-operating with Mr. Myers, will complete the list of State appointees. Mr. Knott will, at an early date, visit the States already organized to study the work being done by the men in the field, and to speed up the inspection program.

Need for Technically-Trained Persons in Patent Office.

Word has been received from J. S. Newton, commissioner of patents, that technically-trained persons are needed for the examining corps of the Patent Office. Men and women are desired who have a scientific education, particularly in higher mathematics, chemistry, physics, and French or German, and who are not subject to the draft for military service. Engineering or teaching experience in addition to the above is valued. The entrance salary is $1500. Examinations for assistant examiner will be held August 21 and 22. Full particulars may be obtained by writing to the Civil Service Commission, Washington, D. C., or to the U. S. Patent Office, Washington.

Trades Preparing for Fourth Liberty Loan.

The United States will next month call upon the men and women of this country to support a great government loan to aid in winning the war. The issue of bonds for the Fourth Liberty Loan will equal or exceed $6,000,000,000. The tentative date for opening the sale of the new certificates is September 28. It will continue about three weeks.

It has been stated that the nation's war programme will necessitate the expenditure of $24,000,000,000 during the fiscal year ending June 30, 1919. This money will be raised in two ways; by taxation and by the issue of bonds.

Taxes of all kinds added $4,000,000,000 to the nation's treasury during the past fiscal year, when total expenses were between twelve and thirteen billion dollars. We cannot contemplate doubling the national budget without increasing the tax income in the same ratio. Plans are now under way to make substantial additions to the amounts derived from war profits and personal incomes. Should these additions swell the tax returns to $8,000,000,000, there would still be left twice this amount to be raised by the sale of bonds.

Enormous as this sum appears on paper, it still barely scratches the surface of our national resources, which, as Thomas W. Lamont recently pointed out, were estimated at the beginning of the war at $250,000,000,000. The total amount derived from the sale of government securities to date is $9,978,785,800.

Appreciation of Work of New York State Commercial Bodies.

In General Orders No. 32, issued from the adjutant-general's office in Albany, N. Y., appreciation is expressed for the valuable assistance rendered by the commercial organization of the State in the recruiting and administration of the new military body known as the New York Guard, now numbering about 21,000 officers and enlisted men.

Heating Men in Military Service.

Wallace F. Goodnow, of the New York branch of the American Radiator Company, has been appointed a first lieutenant in the Construction Division of the Aviation Corps. Before his departure for Washington where he will be located indefinitely he was tendered a dinner at the Machinery Club, New York, by a number of friends including Willis H. Carrier, Arthur Ritter, Thomas N. Chester, Burt S. Harrison, Frank T. Chapman, David Beatty, George G. Schmidt, Charles A. Stevens, E. P. Heckel, E. A. Briner, E. Hilton and J. Barton Garfield.

Albert W. Hills, formerly western representative for the Haydenville Co., Haydenville, Mass., has been commissioned ensign in the navy. He is now stationed at an Atlantic port in charge of coaling ships in the transport service.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Research Committee Inspects Bureau of Mines Testing Station in Pittsburgh.

After approval had been given to the plans of the research committee of The American Society of Heating and Ventilating Engineers, in Buffalo, last June, which included the use of the testing station of the Bureau of Mines in Pittsburgh, a party, made up of members of the committee and others interested, visited Pittsburgh as guests of W. R. Talbot, superintendent of the Pittsburgh station. Included in the party were J. I. Lyle, chairman, J. D. Hoffman, Perry West and H. M. Hart.

An inspection of the facilities afforded by the government's plant for carrying on the research work of the heating engineers' society demonstrated to all that the station was in splendid shape to meet the requirements, being able to provide, in addition, the necessary office space, steam power, light and heat. The members came away enthusiastic over their inspection.

◆

Plans for Advancement of Warm-Air Furnace Heating.

At the recent meeting of the National Warm Air Heating and Ventilating Association, held in Milwaukee, June 12, action was taken to provide for the testing of furnaces and appliances at the new testing station of the University of Illinois at Champaign. A resolution was also adopted urging all furnace manufacturers to voluntarily reduce their lines of furnaces to three styles and five sizes of each style, and to make no size of furnace smaller than a 19-in. firepot.

The testing station at the University of Illinois is so arranged that a furnace may be tested under as nearly actual working conditions as it is possible to obtain. It is really a building within a building, so that a furnace may be set up, with pipes running to the first and second floors. The first year's work, it is expected, will call for an expenditure of $8,000, and is to be borne by the association. The university reserves the right of publication of the data. It was decided that the first tests should be to determine the value of the furnace as a heater.

Dr. E. Vernon Hill, who was one of the speakers, said that the possibilities of ventilating a building are greater with a warm-air furnace than with any other type of heating system, because it provides a means of furnishing warm, moist, clean, moving, fresh air.

New officers were elected as follows:

President, W. G. Wise, Akron, O.; vice-president, John A. Howard, Dowagiac, Mich.; treasurer, I. L. Jones, Utica, N. Y.; secretary, Allen W. Williams, Columbus, O. Executive committee: John D. Green, Detroit; E. P. Miller, Marshalltown, Ia.; G. D. Wilkinson, Chicago; and W. L. Dawbarn, New York.

◆

American Society of Mechanical Engineers.

The following nominations are announced for officers of The American Society of Mechanical Engineers:

For president, Dean Mortimer E. Cooley, Ann Arbor, Mich.

For vice-presidents, F. R. Low, New York; Henry B. Sargent, New Haven, Conn.; and John A. Stevens, Lowell, Mass.

For managers: Charles L. Newcomb, Holyoke, Mass.; F. O. Wells, Greenfield, Mass., and Dean C. R. Richards, Urbana, Ill.

For treasurer, William H. Wiley, New York.

◆

National Organization of Building Industry.

As the result of a meeting of forty representatives of organizations in the building industry, held in New York, June 14, a resolution was adopted to appoint a committee to outline a plan for a proposed national organization of the building industry, first to place its resources at the disposition of the Government and, second, to continue during the war the production of permanent wealth to the largest extent practicable in view of war needs and for conserving the organization of the building industry in such manner that, upon the return of peace, the industry may be prepared as soon as possible to resume its normal activity.

In moving the adoption of the resolutions a letter was presented from President Harry A. Wheeler of the United States Chamber of Commerce in which he stated:

"It is the purpose of the War Service Executive Committee of the Chamber of Commerce of the United States to encourage by every means in its power the organization of all of the industries into trade associations, and to relate allied associations in such a manner that the industries can be completely represented with respect to their participation in war work, and with respect to the maintenance of foundations for carrying on the industry with as little interruption as possible during the period of the war.

"If the building industries generally over the country can be brought together so that groups representing the industry at different cities will create a central committee for the study of the needs of the business, the Chamber of Commerce War Service Executive Committee will be very glad to study the problems with your central body and to exercise any influence it may possess in behalf of legitimate continuation of the building business even though it may not have to do with construction directly related to war purposes."

At a subsequent meeting of the organization committee it was voted that a convention be called for July 15 in Atlantic City, each association connected with the building industry to send one representative to serve, temporarily at least, on a central war service committee.

Over 225 representatives of regional associations of supply, engineering and contracting bodies and of individual manufacturing firms attended the Atlantic City meeting. After a full day's discussion the convention resolved to form the "National Federation of Building Industries," composed of members whose places of business are located or whose products are distributed at large over the United States. The federation is to be managed and its policies developed and carried out by a body of delegates to be known as the "Building War Service Committee."

The federation will be composed of two classes of membership: national, whose products are distributed at large over the United States; and regional, whose products are distributed principally in a city district, locality, State or region. The National Committee of Confederated Supply Association, for instance, comes within the scope of national membership and the Eastern Supply Association within the scope of regional membership.

The "War Service Committee" forms the personal contact between the Federation and the Government. A. M. Maddock, vice-president of the Eastern Supply Association, was elected to membership on the War Service Committee, representing the steam, plumbing and gas supply industries.

It is expected that the new National Federation of Building Industries will solve the great problem that the building industries have been grappling with since the war began, that of unifying the industry.

◆

Speeding Up the Trade Extension Campaign.

At a meeting of the Trade Extension Committee, representing the heating and plumbing manufacturers, jobbers and contractors, in the movement for "Building Bigger Business," June 21, the committee was authorized to start an intensive campaign during the ensuing weeks in some given section, to be selected in accordance with the number of "premise report" cards received.

It was also voted to add to the committee a delegate representing the trade press and the trade papers co-operating in the campaign were authorized to elect such a delegate. James H. Heatherton, of the *Plumbers' Trade Journal,* was elected.

In the course of the discussion it was brought out that while the work is having the support of the manufacturers there is need for greater co-operation on the part of the jobbers.

At the afternon session it was proposed that all manufacturers' and jobbers' associations affiliated in the movement be invited to appoint a delegate and alternate to attend the meetings of the committee.

William J. Woolley presented a plan for enlarging the work of the Trade Extension Committee and making it a permanent adjunct of the trade. He proposed the establishment of a "business efficiency bureau," to be centrally located, to be in charge of a board of governors chosen by representatives of the various associations interested. This matter was referred to the finance committee.

The trade press was given a unanimous vote of thanks for its generosity in donating the series of four-page inserts in furthering the work of the Trade Extension Committee.

◆

Central Station Town Heating Proposed for England.

Already, in England, the vast readjustment that must follow the close of the war is receiving wide attention, especially in engineering circles. A paper recently received from A. E. A. Edwards, of the firm of Edwards & Shaw, consulting engineers, of Birmingham, England, on the subject of "Steam Engines in Relation to the Fuel Economy Problem," gives an insight into the trend of English engineering thought.

The writer first calls attention to the fact that coal is England's most valuable asset and that, unlike other countries in handling their "capital," England is and has been exporting more than a quarter of its coal output each year.

He then refers to the report of the English "Coal Conservation Sub-Committee" with special reference to the committee proposal to divide Great Britain into sixteen districts and to put down central generating stations at suitable points in which the by-products of the coal could be extracted before the coal or the gas from it is used for power production.

Mr. Edwards dwells at some length on the practice so prevalent in England of wasting the exhaust steam from power plants. Steam engine builders, he states, have taken infinite pains to reduce the consumption of steam in engines, from say 12 lbs. per horsepower to 11 lbs. This is a 9% reduction of coal, but it means that we are getting 9% efficiency out of the coal burned instead of 8% previously obtained. He then proceeds:

"My proposal is that, instead of turning 61% of heat into the condenser or blowing it into the atmosphere, we heat water at the station by condensing the steam at a low vacuum and pump this hot water round the district to form a heating and hot-water service." He calls attention to the wide use of this system in America and adds that it is employed in very many of the large institutions in England, but has never been applied to town heating except in Manchester, where the Electric Supply Company is now supplying exhaust steam for heat and hot water to several large blocks of buildings.

Mr. Edwards also refers to the possibilities of using such a plant in the summer time for making ice or refrigeration on the ammonia absorption system.

"Why aim," he adds, "at a grand elaboration of supply stations with their enormous cost, etc., when with a simpler plant right on the spot, you can get at least 36%, and with a thoroughly efficient plant, 49% efficiency?"

In the discussion that followed the reading of Mr. Edwards' paper it was pointed out by one speaker that the electrification of railways is closely wrapped up with the proposal to establish a number of super power stations and that this is of the greatest national importance at the present time. He endorsed, however, the scheme for establishing small generating stations in residential parts of the cities on the plan outlined by Mr. Edwards.

In the United States, according to E. W. Rice, Jr., in a recent issue of the *General Electrical Review*, where electricity has been substituted for steam in the operation of railroads, fully 50% increase in available capacity of existing tracks and other facilities has been demonstrated. It is estimated that something like 150,000,000 tons of coal were consumed by the railroads in the year 1917. It is now known, from the results from such electrical operation of railroads as we already have in this country; that it would be possible to save at least two-thirds of this coal if electric locomotives were substituted for the present steam locomotives. On this basis there would be a saving of over 100,000,000 tons of coal in one year. This is an amount three times as large as the total coal exported from the United States during 1917.

CORRESPONDENCE

Circulation in Pipe Coils.

EDITOR HEATING AND VENTILATING MAGAZINE:

Can you kindly answer the following questions which have been puzzling me?

An old forced hot-water installation is equipped with numerous horizontal return-bend pipe coils. These are constructed of 2-in. pipe, 15 high and about 16-ft. long, making a total of 240 lin. ft. of pipe. The coils are arranged horizontally. It is intended to convert the system into a vacuum system, with the supply in the top line and the return at the lower end with a trap.

First: Will the circulation be perfect with a coil of this size and height? Also what is the limit for return bend coils?

Second: Would it not be advantageous to change these coils to "miter-coils"?

Third: Can "bucket-type" traps be used satisfactorily without blowing steam into the returns?

Chicago. A. W. H.

Our correspondent speaks of having "numerous horizontal coils . . . . of 2-in. pipe 15 high." Also that he expects to convert the system to vacuum-steam "with the supply in the top line and the return at the lower end." We have always construed a "horizontal" coil as being one in which the pipes are all in the same horizontal plane, such as occurs in ceiling coils and a "vertical" coil as one where the pipes all lie in the same vertical plane, such as wall coil. It is difficult for us to know what the "top line" and "bottom end" would be in a flat ceiling coil unless our correspondent refers to the slight difference in elevation due to the pitch.

If wall coils are referred to (as we believe) there will be no trouble experienced in changing over to vacuum steam provided the coils pitch down continuously from the top inlet to the bottom outlet, as they should.

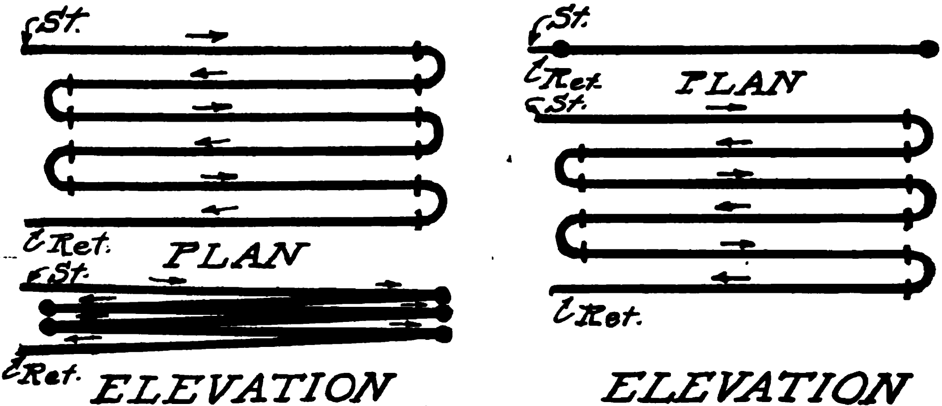

FIG. 1.

HORIZONTAL COIL (CEILING). VERTICAL COIL (WALL).

With ceiling coils it is not likely that it would be practical to hang these so as to give a continuous pitch as each pipe in a return-bend coil would pitch in a different direction from the next two adjacent pipes and must run on a slightly different level. This is illustrated in Fig. 1 where both a wall and ceiling coil are shown, the direction of the proper pitch downward being indicated by arrows. If the coils *can* be pitched properly and continuously there is no reason why even a return-bend ceiling coil would not work perfectly.

So far as we can see, the only advantage of using a miter coil is that the steam travel would be reduced from 240 ft. to 16 ft. in each coil, thus saving 224 ft. of length. This might require—in some cases—a jumping of the steam main up one size in order to care for the longer travel, although if the steam pressure is to be carried at 3 to 5 lbs. gauge there need be no increase of size.

As far as bucket-type traps are concerned, they will cost six to eight times as much as a good thermostatic or water-seal valve and will not handle air. The only way such traps can be utilized is to connect them for handling the water only and by-pass them with an air line in which is placed a small thermostatic valve for air relief. This is illustrated in Fig. 2. We recommend using a standard radiator trap of proper size for such work as these are a true economy in the long run. The trap connection should be made as shown in Fig. 3, with a dirt pocket to prevent dirt and scale getting into the valve and causing trouble.

Figuring Pipe Sizes for Steam, Water and Air.

Editor Heating and Ventilating Magazine:

In regard to your article published on page 51 of the January issue, please tell me how to figure pipe capacities, using friction. That is, if you have given the required capacity and the pressure, also the distance to be transmitted, how will you determine the pipe size for steam, water, and air.

Utica, N. Y. C. A. C., Jr.

To figure pipe capacities, making an allowance for friction, the usual procedure is to consider four factors; these consist of the quantity to be delivered (Q), the length or run (L), the equivalent length of run (EL), the total drop allowable (D) and the size of pipe (d). Where the medium to be handled is compressible (such as steam or air) the pressure (P) must also be considered.

Since the pressure (P) does not enter into the calculation of pipe capacities for water this is the simplest of the three cases to consider. It must be remembered,

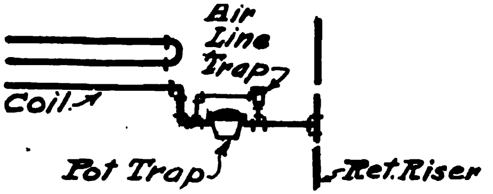

FIG. 2.—POT TRAP RETURN CONNECTION.

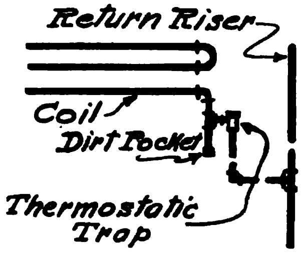

FIG. 3.—COMMON VACUUM RETURN CONNECTION.

however, that all formulæ relating to the capacities of pipes are, at the best, only approximate. This is owing to so many variable factors being present; a formula correct for new clean pipe will not be correct at the end of several years when the pipe is more or less corroded and obstructed by dirt and scale; nor will a formula for pipe with the burr properly reamed out apply to a line where the pipe is installed unreamed; similarly common short-turn steam, air and water fittings will cut down the delivery of a pipe over what will be obtained with long-radius fittings and sweep tees, while pipe bends further increase the delivery by reducing the friction still more.

Tables are available in many reference books giving the loss due to friction for 100 ft. of run of straight pipe for various water deliveries in gallons per minute. These tables do not take fittings into consideration and the most practical method of handling the fittings is to reduce them to equivalent length of straight pipe. Thus a common 4-in. elbow handling a certain number of g.p.m. will produce a frictional effect equal to a certain number of feet of straight run of pipe without a fitting. This equivalent run for each fitting is then added to the length of the line (L) or actual length + equivalent length for each fitting × number of fittings = total equivalent length (EL).

For fittings one authority gives the following as the approximate length of straight pipe whose friction would equal the fitting:

Globe valves	= 60 pipe diameters
90° ells	= 40 pipe diameters
Return bends	= 80 pipe diameters

Gate valves and tees on the run may be neglected; tees on the branch may be considered as equivalent to an elbow; ells of 45° or 22½° are equal to about one-half and about one-quarter, respectively, of the length given for a 90° ell.

For the losses on straight pipe, use the tables of friction losses (based on Ellis and Howland's experiments) as given in Kidder's "Architects and Builders Pocket Book" and quoted in many manufacturers catalogs.

For example: To compute the size of pipe necessary to meet the conditions illustrated in Fig. 1, assuming the street main carries a pressure of 60 lbs., that the highest outlet on the pipe is 100 ft. above the main and that 10 lbs. pressure must be maintained on this outlet when the maximum flow of 50 gal. per minute (Q) is maintained.

Adding up the actual length of run (L) from the tee on the street main to the outlet gives

20
30
40
20
15
30
25
40
30
30
10
—
290 ft. actual length of run (L)

To this must be added

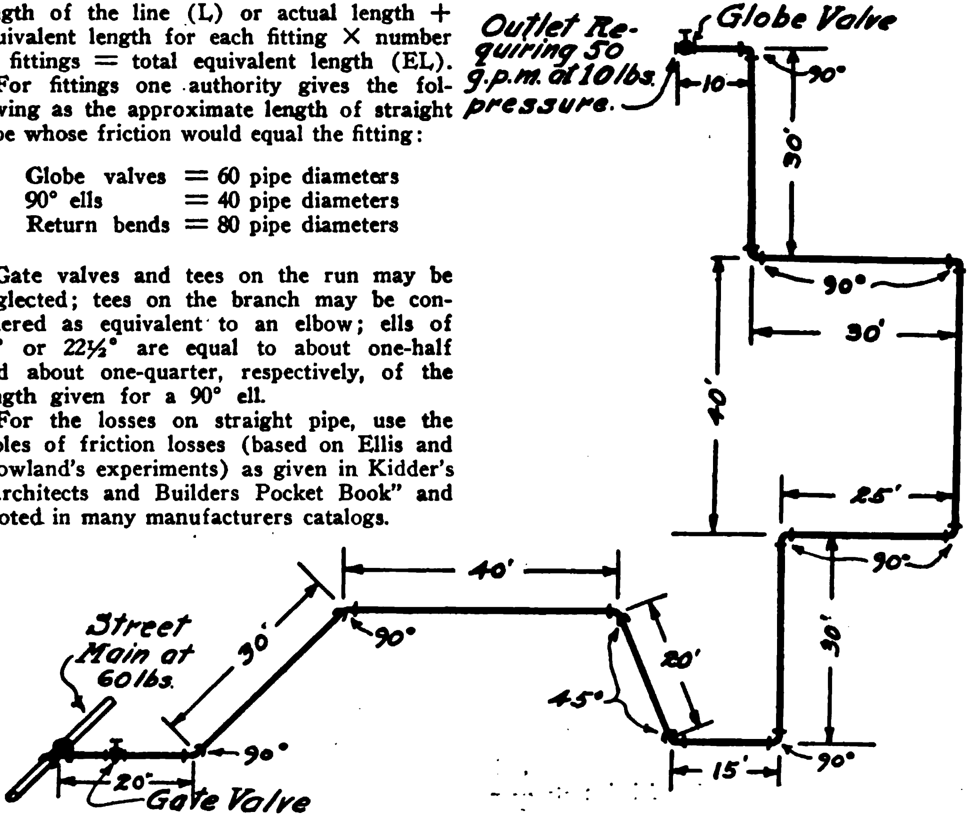

FIG. 1.—PIPING ASSUMED FOR CALCULATIONS.

1-tee on the branch
8 — 90° ells
9 × 40 diameters = 360 diameters.

2 — 45° ells
2 × 20 diameters = 40 diameters.

1 Globe valve
1 × 60 diameters = 60 diameters.

Total 460 diameters

So the equivalent length is equal to

290 ft. + 460 diameters.

If the street main maintains a pressure of 60 lbs. gauge and the rise is 100 ft., the hydraulic pressure at the outlet when no water is running will be

60 — (100 × 0.43 lbs.) = 60 — 43 = 17 lbs. As 10 lbs. must be maintained at the outlet when running 50 g.p.m. the friction drop in the line between the tee on the street main and the outlet must not exceed 17 — 10, or 7 lbs. As the total length of run is around 300 ft., this is a drop (D) of 7/3 = 2.3 lbs. per 100 ft.

Referring to the friction table previously mentioned it is found that for 50 g.p.m. the friction loss in 100 lin. ft. of pipe is

10. lbs. for 1½-in. pipe
2.44 lbs. for 2-in. pipe
0.81 lbs. for 2½-in. pipe

This shows that 2 in. is the correct size (without considering fittings) giving a total equivalent run of

$$290 \text{ ft.} + \left(460 \times \frac{2}{12}\right) \text{ or}$$

290 ft. + 77 = 367 ft. equivalent length (EL) with fittings. 7 lbs. total allowable friction $\div \frac{367}{100}$ = 1.9 lbs. per 100 ft. allowable friction drop (D). Since the friction on 2-in. pipe is 2.44 and is for clean pipe only, 2½-in. pipe would be the proper size to use, this giving

$$290 + \left(460 \times \frac{2\frac{1}{2}}{12}\right) =$$

290 + 96 .... = 386 ft. equivalent length (EL) 7 lbs. total allowable friction $\div \frac{386}{100}$ = 1.8 lbs. per 100-ft. drop (D) allowable against 0.81 actual on 2½-in. pipe. Therefore, this is the correct size under the conditions named.

The discussion of the various formulæ developed for determining the flow of steam in pipes is too great a subject to be entered into here, but as most of these formulæ have been computed for various conditions the easiest way to obtain the approximate discharge of a steam pipe is by use of some table calculated from a reliable formula.

Table 66 and 67 in Babcock and Wilcox's book "Steam" will probably help our correspondent, one of the tables being calculated for pipes 240 diameters in length at various pressures and 1 lb. drop, while the other is based on pipes 1,000 ft. long at various drops and pressures.

The same pipe illustrated in Fig. 1 may be taken as an example for steam to avoid calculating another line. Assuming the main carries steam at 111 lbs. gauge, or 126 lbs. absolute pressure, and that 50 lbs. of steam per minute (Q) at 109 lbs. gauge, or 124 lbs. absolute pressure, are required at the outlet. Then the allowable drop is 126 — 124 = 2 lbs. for about 300 ft. of run, or 0.66 lbs. per 100 ft., or 6.6 lbs. drop for 1,000 ft.

Referring to the Table 67 mentioned it is seen that at 6.6 lbs. drop 125 lbs. (average absolute pressure in line) steam will require between a 3-in. and a 4-in. pipe.

Then to re-calculate accurately, the total equivalent length of run is 290 + 460 × 4/12 = 443 lin. ft.

2 lbs. ÷ 443/1000 = 4.5 lbs. drop per 1,000 ft.

Referring again to Table 67, it is found that, at 125 lbs. absolute average pressure and 4.33 lbs. drop per 1,000 ft., the delivery for a 3 in. pipe is 31.9 lbs. of steam per minute and, for a 4-in. pipe, 70.6 lbs. per minute. Therefore, 4 in. is the correct size or, possibly, 3½ in., if such pipe is obtainable.

It must be remembered that in very long runs of steam pipe the factor of condensation enters to a considerable degree. This is not so noticeable in larger lines because the condensation constitutes relatively such a small proportion of the total steam handled. On the smaller sizes it must be carefully considered as it is not at all impossible to decide on a small pipe which, on the basis of friction drop, delivery, etc. would be large enough for the purpose yet which might condense all, or nearly all, the steam before the other end is reached. This can only be allowed for by approximating such radiation losses and increasing the delivery into the pipe by an equal amount.

With compressed air no condensation need be considered and, according to a formula published in the *American Machinist* by J. E. Johnson, Jr., Table 9, p. 48, in Harding and Willard's book on "Heating and Ventilation" has been computed, this table being based on $P_1^2 - P_2^2$ in which P_1 is the initial absolute air pressure in pounds per square inch and P_2 the absolute terminal pressure.

Taking the same pipe line as given in Fig. 1 and figuring for the same delivery in cubic feet of air as was used for steam with the same pressures and drop, the problem becomes:

50 lbs. of steam per min. @ 125 lbs. abs. pressure = 50 × 3.6 cu. ft. = 180 c.f.m.

To reduce this to free air $V_1 : V_2 :: P_2 : P_1$ or $V_1 : 180 :: 125 : 15$

$180 \times 125/15 = V_1 = 1{,}500$ c.f.m. of free air.

Since the initial pressure is 126 lbs. abs. and the terminal pressure 124 lbs. abs.

$P_1^2 - P_2^2 =$

$126^2 - 124^2 = 15{,}826 - 15{,}376 = 500$

$$500 \div \frac{300}{100} \text{ length of run} = 166 \text{ per } 100 \text{ feet.}$$

According to Table 9, a 3½-in. pipe for 1,500 cu. ft. will give a difference of $P_1^2 - P_2^2$, as 214.2 or more drop than allowable, while a 4-in. pipe shows 109.9, or less drop than permissible. Assuming a 4-in. pipe is correct, then the total equivalent length (EL) becomes the same for steam (443 ft.) or

Then $126^2 - 124^2 = 500$

$$500 \div \frac{443}{100} = 113 \text{ per } 100 \text{ ft. difference}$$

of squares.

As a 4-in. pipe has drop enough to give only 109.9 difference in squares it is just on the safe side.

◆

New Publications.

Sheet Metal Workers' Manual, by L. Broemel and Professor J. S. Dougherty of the Carnegie Institute of Technology, Pittsburgh, is the title of a new work which takes up both elementary and advanced sheet metal work. A chapter is devoted to sheet-metal working machine and tool construction, explaining their application and uses. The book comprises fifteen chapters and has over 400 illustrations. Price $2.00. Published by Peck, Stow & Wilcox, Southington, Conn.

Essentials of Sheet Metal Work and Pattern Drafting, is one of the new books, bein especially written for teachers and students and described as a reply by the pioneer manufacturer in the sheet and metal machine and tool industry to numerous requests for information regarding classroom work suitable for grade and high schools. The author is J. S. Dougherty, instructor in sheet metal work in the School of Applied Industries, Carnegie Institute of Technology, Pittsburgh. Price $1.50. Published by Peck, Stow & Wilcox Co., Southington, Conn.

Effects of Moisture on the Spontaneous Heating of Stored Coal, by S. H. Katz and H. C. Porter is the title of a recent technical paper issued by the Bureau of Mines, Pp. 25, 9 illustrations. It is listed as Technical Paper No. 172.

Weights of Various Coals, by S. B. Flagg, are given in Technical Paper No. 184, recently issued by the Bureau of Mines. Many different kinds of coal have been tested and analyzed by the Bureau of Mines in the course of its investigations relating to the purchase and use of fuel by the Government. Advantage has been taken of the opportunity thus afforded to obtain information as to the differences in weight of the different varieties. Pp. 11.

Pipe and the Public Welfare is the title of a book of unusual interest written by R. C. McWane, manager of the Cast-Iron Pipe Publicity Bureau, New York. The text is largely historical, taking up, among other things, the early uses of pipe from the time of the Delhi Pillar to its first uses in France, London and the United States. Another chapter is devoted to the materials and methods of making metal pipe. The deterioration of metal pipe is discussed on the basis of many actual experiences. A separate chapter is given over to wood pipe. Much of the interest of the book is to be found in the popular style in which the book is written and in the illustrations which are numerous and carefully chosen. The author makes out a strong case for the lasting qualities of cast-iron pipe, especially as to its resistance to rust. On this subject he states: "It will be noted that cast-iron has a distinct granular or crystalline structure, a form common to all metals having undergone the simple prosess of smelting and cooling, which was one of the processes of Nature in the formation of the ore, and it is this distinctive structure, in combination with the chemical, or electro-chemical, action taking place on the surface of the metal, which serves to stop that action, after it has proceeded to a certain depth, and hold the result (ferrous oxide) as a permanent, oxygen-excluding protective coating. This stoppage of rust action results from the fact that the crystals, or granules, in cast-iron are bound together at one or more points by a metallic bond, or bonds, and after a rust coating has been formed of the loose crystals on and near the surface of the metal, and the oxide penetrates between the crystals more strongly bound together, the force exerted by the absorption of moisture is not sufficient to separate the crystals, and the oxide remains as a permanent coating." Size 5x7¾ in. Pp. 165. Price $2.00.

A HANDBOOK ON PIPING, by Carl L. Svensen, B. S., assistant professor of engineering drawing in the Ohio State University, is one of the new books of the year which will be found a valuable addition to the heating engineers' library, although the scope of the book takes in practically every use of pipe. Following a historical discussion, chapters are devoted to dimensions and strength of pipe, pipe threads, pipe fittings and pipe joints. These are followed by chapters on standard and special valves. Under "Steam Piping" the matter of design is treated at length, with notes on the ring and duplicate systems, steam loop, etc. Piping for heating systems has a chapter to itself and covers both independent and central station systems. Size 6 x 9 in. Pp. 359, indexed and accompanied by eight large plates of piping layouts and 359 other illustrations. Price $4.00 net. Published by D. Van Nostrand Co., New York, and may be had through the book department of The Heating and Ventilating Magazine.

A STUDY OF THE HEAT TRANSMISSION OF BUILDING MATERIALS is the subject of a valuable bulletin (No. 102) issued by the Engineering Experiment Station of the University of Illinois. The authors are A. C. Willard, Professor of heating and ventilation at the university, and L. C. Lichty, research fellow, of the Engineering Experiment Station. A fuller report of the series of tests on which the study is based will be presented in a later issue of THE HEATING AND VENTILATING MAGAZINE. For the present it will be sufficient to say that the tests were made with the so-called "hot air box" method in which the box is made entirely of the material to be tested. Heat was supplied by electrical means. The amount usually operated through the material was determined from the combined electrical input to the heater and to the fan motor. The tests cover both still air and moving air conditions. Their extent and the care with which they were made will no doubt give them rank as one of the classical series of experiments made in this field. While the results do not vary greatly from those of previous tests some important items are brought out, such as the fact that a variation in the air velocity over the surface affects both the air-to-air coefficient and the outside surface coefficient. Also, the effect of the relative humidity of the air on the heat transmission of an ordinary wall is so small that it can safely be neglected in determining the total heat loss from a building. Finally it is brought out that air-space construction is of value at low temperatures, but not at high temperatures. Size 6 x 9 in. Pp. 56.

MAXIMUM PRICES OF COKE, with modification showing dates when effective, corrected to April 1, 1918, has been published by the United States Fuel Administration (Publication No. 24).

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CARRIER AIR DRYING SYSTEM, as applied to the paper manufacturing plant of the Certainteed Products Co., Niagara Falls, N. Y., is presented in a carefully-prepared engineering circular by the Carrier Engineering Corporation, New York. While working on 50-lb. felt for the company's 2-ply Certainteed roofing, 20-min. runs were made with and without the Carrier system in operation and with felt coming off, the machines equally dry in both instances. With the Carrier system and air in its ducts at a temperature of 160° F., 100 ft. of felt per minute were run off with a total weight of 1025 lbs. for the 20 minutes. Without the Carrier system the production was 88 ft. per minute, with a total of 890 lbs. for the 20 minutes. While the air-drying system was in operation 55% of moisture was present in the air surrounding the machine. Without it, the percentage ran up to 83. The production increase was 15.1%. On other pages of the circular the installation is described in detail, accompanied by photographs giving the reader a very clear idea of the operation of the system for this class of work.

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Deaths.

Charles F. Belcher, treasurer of the Walker & Pratt Mfg. Co., Boston, Mass., died at his home in that city, July 8. He had been connected with the company since 1874.

Trade Literature.

INTERNATIONAL ECONOMY BOILERS, "tested and rated in accordance with the code adopted by the American Society of Heating and Ventilating Engineers," are presented in a new engineering catalogue, issued by the International Heater Co., Utica, N. Y. The catalogue will be found of special interest to the heating engineer on account of its frank and intelligent discussion of the principles of design of the Economy boilers and their various parts. The heating engineers' boiler code is given warm approval in the catalogue and a separate publication on the company's testing plant shows how closely the company has followed the code as set forth, with one exception, that of separating the ash from the unburned coal in the residual. The company's engineering department states that this was given up as impractical and as not nearly so accurate as the coal analysis. It is suggested that a dry steam tests might be included in the code at a future meeting of the society. Size of catalogue 6 x 9 in. (standard). Pp. 24. The International Heater Company has also issued a timely circular on "Best Ways to Run a Boiler," being a book of simple rules for steam and water boilers. A copy, it is stated, is shipped with each boiler.

ICE AND FROST is the title of a unique catalogue and house journal published by the Frick Co., Waynesboro, Pa. The current issue (Series A, No. 4) is devoted especially to small refrigerating plants and some of their uses, suitable for clubhouses and private dwellings, chocolate and candy factories, small hotels, and apartment houses. The system illustrated is the direct-expansion system in which the necessity of additional power for forcing brine through the cooling pipes is eliminated. Several types of the company's line of compressors are shown, as well as closed-flow and open-flow ammonia condensers. These are accompanied by typical complete installations for a variety of uses. Size 6 x 9 in. Pp. 34.

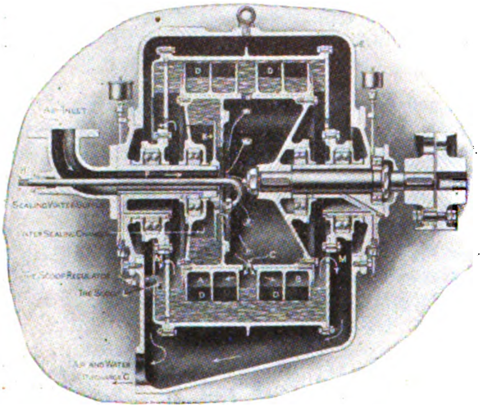
ILLINOIS THERMO, described as the "super trap" for vacuum, vapor and modulating systems, are featured in a new booklet issued by the Illinois Engineering Co., Chicago, Ill. Special attention is called to the vertical seat of this trap so that dirt does not lodge or lie on it. Attention is also called to the fact that the diaphragm closes against the steam and not in the steam, so that it does not have to wait until the water condenses in the radiator and cools off before opening. The diaphragm is made with concave sides to give flexibility without strain on the diaphragm. It has a ball and cone seat. The trap is made of phosphor bronze of 90,000 lbs. tensile strength and the bodies are of steam brass. The same circular shows the Illinois modulating supply valve, of the quick-opening type, lever-handles.

TYCOS MINERAL OIL TABLETS, giving their gravity and temperature from determinations of the Bureau of Standards, and other tables for general testing and refinery practice, compiled and edited by E. N. Hurlburt, are published in cloth covers by the Taylor Instrument Companies, Rochester, N. Y. The tables are fully indexed. Size 4¾ x 6½ in. Pp. 204. Price $1.00.

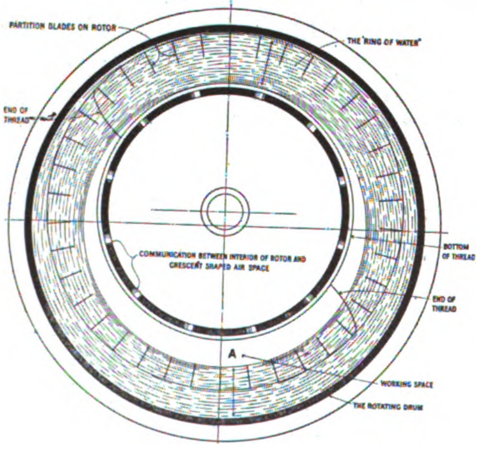
BUFFALO FORGES of the portable type, are illustrated and described in a new catalogue (Section 100) issued by the Buffalo Forge Co., Buffalo, N. Y. Attention is called to the fact that Buffalo forges have been on the market for 40 years and the extensive line shown in the catalogue attests the wide field covered by this department of the company. Size 5 x 7½ in. Pp. 112.

MARVEL TEMPERATURE REGULATORS, described as the first and only all electric clock, thermostat and motor, is featured in a blanket circular issued by the American Thermostat Co., Newark, N. J. Aside from the nightly adjustment of the thermostat to reduce temperature to the sleeping hours' standard, and the one setting of the clock to indicate the morning hour at which increased warmth is desired, the all-electric Marvel, it is stated, requires no attention from the householder; the clock winds itself once every 60 seconds. Other specialties made by the company and shown in the circular are the Marvel motor valve for radiator and valve control and the Marvel hot water thermostat for circulating hot water systems. The Marvel motor valve consists of a Gorton-type quarter-turn packless cone valve, to the post of which is directly connected the master Marvel valve motor, non-reversing and universal, operating on either alternating or direct current of 110 volts. Where steam or hot water circulating is constant, it is possible with this device to control individual radiator units or a connected system of units.

GLOBE-JOHNSTON ROTARY VACUUM PUMP AND CONDENSER, described as applicable to practically every process where vacuum or low-pressure compressed air is required, has been brought out by the Globe Pneumatic Engineering Co., Ltd., 1 Victoria St., London, S.W. 1, and is described in great detail in a catalogue recently received from this company. This unit is featured as truly a rotary pump and truly valveless. It consists of two main parts, the rotor and the drum. The rotor is a hollow member on the outer circumference of which deep double-thread screws are formed. A passage runs between the twin-screw threads into the interior of the rotor. When the machine is producing a vacuum this passage acts as an inlet to the screw-threads, but when air is being compressed it is the outlet. Similarly the pipe running from the interior of the rotor to the exterior of the machine is the inlet pipe in the vacuum pump and the outlet pipe in the compressor. The screw threads are joined by a large number of narrow partitions or blades which are equally spaced around the periphery of the rotor. The outer and inner edges of these blades are repeatedly flush with the top of the screw-threads and half way down the depth of the threads. A ring of water is, in the first place set up by the action of these blades in conjunction with centrifugal force. Annular rings, called shrouding plates, fitted to the sides of the rotor and reaching somewhat below the water level on the discharge side, prevent the exhausted or compressed air returning along the screws when the thread ends leave the water-seal. The rotor is coupled direct to the shaft and is carried on massive self-aligning ball-bearings.



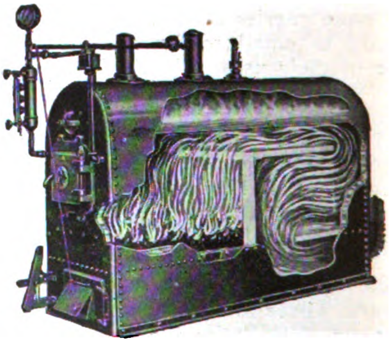
THE GLOBE JOHNSTON ROTARY VACUUM PUMP.


PARTITION BLADES ON ROTOR
THE "RING OF WATER"
END OF THREAD
COMMUNICATION BETWEEN INTERIOR OF ROTOR AND CRESCENT SHAPED AIR SPACE
BOTTOM OF THREAD
END OF THREAD
A
WORKING SPACE
THE ROTATING DRUM

DIAGRAMMATIC SECTION, SHOWING "RING OF WATER."

The holes in the side of the drum act as discharge and inlet openings for vacuum pump and compressor, respectively. The drum when rotating, contains the "ring of water," and is set eccentrically to the rotor. The relative eccentricity of the rotor and water ring produces what is called the working space. Other details of the pump include a scoop chamber and scoop for maintaining the correct depth in the ring of water, and a water-seal which is merely a substitute for a stuffing-box. Size of catalogue 7¼ x 9¾ in. Pp. 32.

Kroeschell Tubeless Boiers for steam, hot water, vapor or vacuum heating systems, described as something entirely new in heating boilers, are presented in a new circular issued by Kroeschell Bros. Co., Chicago, Ill. This boiler is built in one piece, with a long-downward fire travel. It is also described as having self-cleaning direct fire surface. In connection with the circulation, the manufacturers state that this boiler contains less water than any boiler of equal capacity and that this, with the upward circulation of this small body of water in the thin waterways, insures most rapid heat transference. Any kind of fuel can be used, including hard or soft coal, wood, gas or oil. Another feature mentioned is that the boiler requires no assembling of parts but is shipped set up com-



CONSTRUCTION OF KROESCHELL TUBELESS BOILER.

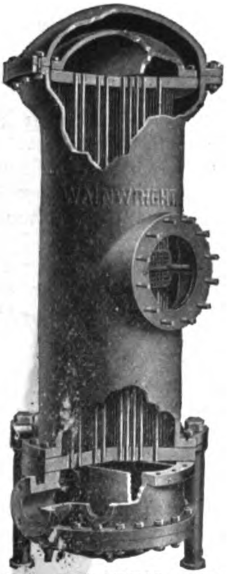
plete. The boiler is furnished up to 3000 sq. ft. radiation capacity in the steam sizes and up to 4000 sq. ft. in the water sizes.

◆

A Floating-Head Service Heater.

A floating-head service heater of the instantaneous water-tube type is a new product manufactured under the name of "Wainwright" by the Alberger Pump & Condenser Co., New York. The water flows through the several passes of tubes and the steam around the tubes. Due to the high rate of heat transmission obtainable by this arrangement, the design permits the use of a smaller heater, thus reducing the space requirements, as well as the initial and installation costs of the apparatus.

The shell, tube-heads, water channel and covers are made of cast-iron, assuring least possibility of corrosion, and, as the brass tubes are straight and smooth, the friction loss is reduced to a minimum. Frequent temperature expansion of the tubes, due to intermittent service, is taken up by the floating head so designed to eliminate the possibility of tube breakage. The use of water channel permits of ready access for cleaning without breaking of any pipe connection, and also permits convenient tube replacement in the event of accident. Straight tubes also avoid the necessity of removing any but the damaged tubes in case of replacement.



WAINWRIGHT FLOATING HEAD SERVICE HEATER.

The Wainwright floating-head service heater, it is stated, can be furnished for any capacity and temperature requirements and can be designed to heat the water to within 5° of the temperature of either the exhaust steam or live steam available, if required.

◆

Jas. P. Marsh & Company in Fifty-third Year of Business.

Jas. P. Marsh & Company, Chicago, Ill., have entered their fifty-third year in the manufacture of gauges, valves and traps. The company specialties are in use the world over and the firm has a reputation of being originators, as well as pioneer manufacturers.

Three separate catalogues have recently been published embracing the company's extensive line. Catalogue No. 52V is devoted to the line of Marsh automatic air valves, Marsh air line valves, Marsh radiator traps, and incidental heating specialties. Catalogue No. 52G covers the complete assortment of Marsh standard and special indicating and recording gauges; also kindred instruments, including indicating and recording thermometers. Catalogue No. 52 is a general catalogue combining in one book the complete line of Marsh gauges, valves, traps and steam specialties. Copies of these catalogues may be had on request.

GAUGES
VALVES
TRAPS
Jas. P. Marsh & Company Chicago
CATALOG NO. 52
GAUGES
Jas. P. Marsh & Company Chicago
CATALOG NO. 52-G
VALVES
TRAPS
Jas. P. Marsh & Company Chicago
CATALOG NO. 52-V

RECENT MARSH CATALOGUES.

◆

Scrap Iron Needed by Mills.

The iron and steel trade is calling attention to the importance of turning in scrap iron for which the demand at the mills is exceedingly heavy at the present time. All who have scrap iron under their control are urged to market it at the first opportunity. It is stated that the odd lots to be found all over the country would make a tremendous total.

Index of Standard Heating and Ventilating Data Sheets.

Included in the accompanying index of Standard Heating and Ventilating Data Sheets are those published during the past half year. In future it is planned to publish the complete index every six months.

Extra copies of any of the data sheets, printed on one side only, may be had at 5 cents each, or $2.00 for a year's supply of 48 sheets. Attention is also called to the fact that a special binder is provided for these Data Sheets, which will be mailed to any address on receipt of the price, $1.00. The binders are suitably stamped and are made especially to hold the Data Sheets.

No.	Date	Issued	Subject
			B.T.U. Losses
1	Feb.,	1917	General.
1-A	"	"	Brick.
1-B	"	"	Stone and Concrete.
1-C	"	"	Combinations.
1-D	March,	"	Tile.
1-E	"	"	Frame Construction.
1-F	"	"	Glass, Skylight and Miscellaneous.
1-G	"	"	Ceiling, Floor and Roof.
			Exposure
2	April,	1917	General.
			Leakage
3	April,	1917	General.
			Temperature Range
4	April,	1917	Minimum Temperatures in U. S.
4-A	"	"	Minimum Temperatures in U. S. (continued).
			Computing Heat Losses
5	May,	1917	General.
5-A	"	"	Example.
			Ventilation
7	May,	1917	General.
			Air Changes
8	May,	1917	Churches and Theatres.
8-A	June,	"	Hospitals.
8-B	"	"	Hotels and Libraries.
8-C	"	"	Schools.
8-D	"	"	Miscellaneous.
			Properties of Air
9	July,	1917	Tables.
			Ducts and Flues
10	July,	1917	General.
10-A	"	"	Elbows.
10-B	"	"	Anemometer Readings.
10-C	August,	"	Underwriters' Rules.
10-D	"	"	Underwriters' Rules (continued).
10-E	"	"	Underwriters' Rules (continued).
10-F	"	"	Velocities Recommended.
10-G	Sept.,	"	Vent Flue Velocities.
10-H	"	"	Areas of Pipes.
10-I	"	"	Areas of Pipes (continued).
10-J	"	"	Pipe Capacities at Various Velocities.
10-K	April,	1918.	Weight of Sheet Metal Pipes.
10-L	April,	1918.	Factors to Change Gauge.
10-M	April,	1918.	Sizing Ducts and Flues—First Method.
10-N	April,	1918.	Sizing Ducts and Flues—Second Method.
10-O	May,	1918.	Sizing Ducts and Flues—Third Method.
10-P	May,	1918.	Sizing Ducts and Flues—Third Method (Cont'd).
10-Q	May,	1918.	Sizing Ducts and Flues—Fourth Method.
10-R	July,	1918.	Sizing Ducts and Flues—Fifth Method.
10-S	July,	1918.	Sizing Ducts and Flues—Fifth Mehtod (Cont'd).
			Duct and Flue Details
11-A	Feb.,	1918	Flue Outlets and Dampers.
11-B	"	"	Details of Reversing Dampers.
			Symbols.
12	March,	1918.	Heating and Ventilating Symbols.
			Radiation
13	Jan.,	1918	Radiation Computing.
13-A	"	"	Radiation Efficiencies.
13-C	"	"	Radiation Computing—Example.
			Radiators
14-A	Jan.,	1918	American 1-Col. Rococo.
14-B	Feb.,	"	American 2-Col. Rococo.
14-C	"	"	American 3-Col. Rococo.
14-D	March,	1918.	American 4-Col. Rococo.
28-G	May,	1918.	H. B. Smith Co.'s 1-Col. Princess.
28-H	July,	1918.	H. B. Smith Co.'s 2-Col. Princess.
28-I	July,	1918.	H. B. Smith Co.'s 3-Col. Princess.
			Chimneys
100	Oct.,	1917.	General.
100-A	"	"	Residence.
100-B	"	"	Residence (continued).
100-C	"	"	Coal and Air per B.H.P.
100-D	Nov.,	"	Draft Loss in Fire and Boiler.
100-E	"	"	Draft, Theoretical and Effectual.
100-F	"	"	Draft, Theoretical, of Stacks.
100-G	"	"	Friction Losses in Steel Stacks.
100-H	Dec.,	"	Friction Losses in Brick Stacks.
100-I	"	"	Summary and Draft Reading.
100-J	"	"	Example of Computation.
100-K	"	"	Costs.
			Fittings.
107	June,	1918.	Rules for 1915 Std. Wt. Flanged Fittings.
107-A	June,	1918.	Std. Wt. Pipe Flanges and Bolts.
107-B	June,	1918.	Std. Wt. Elbows and Reducers, Flanged.
107-C	June,	1918.	Std. Wt. Straight Tee Crosses and Laterals, Flanged.
			Exhauster Systems.
169-E	March,	1918.	Exhauster Systems—Weight of Sheet Metal Pipes.
169-F	March,	1918.	Factors to Change Gauge.

Danger of Error in Short-Period Tests.

"A man breathes sixteen times in a minute. It is not enough to prove that the air he breathes in once will not harm him, nor that sixteen breaths of it will not harm him, nor the 960 breaths in an hour, nor the 23,040 breaths in a day.

We note that actually a man may go for a month or three, or a year or ten, without seeming to be harmed by bad air, and then may begin to get pale, crotchety, out of sorts, or actually ill. Or, again, a man may go along in good shape for three months and then catch a cold or measles or pneumonia. All of these things may happen and foul air be the most important factor in causing them, even though it has been proven that men are comfortable and well as a rule for an hour a day or a week in four air, provided it is kept right as to temperature, humidity, and movement.

"It is somewhat like drinking milk. The harmful milk for babies in summer is that which looks, tastes, and smells all right, that which on analysis seems to be passable at any rate.—Dr. W. A. Evans in the *Chicago Tribune*.

SIZING DUCTS AND FLUES.
METHOD NO. 6

NOTE—For explanation and example assumed see Standard Data Sheets Nos. 10-M and 10-N.

The Buffalo Forge Co. utilizes two methods for sizing ducts and flues, one system for industrial work and another for public buildings.

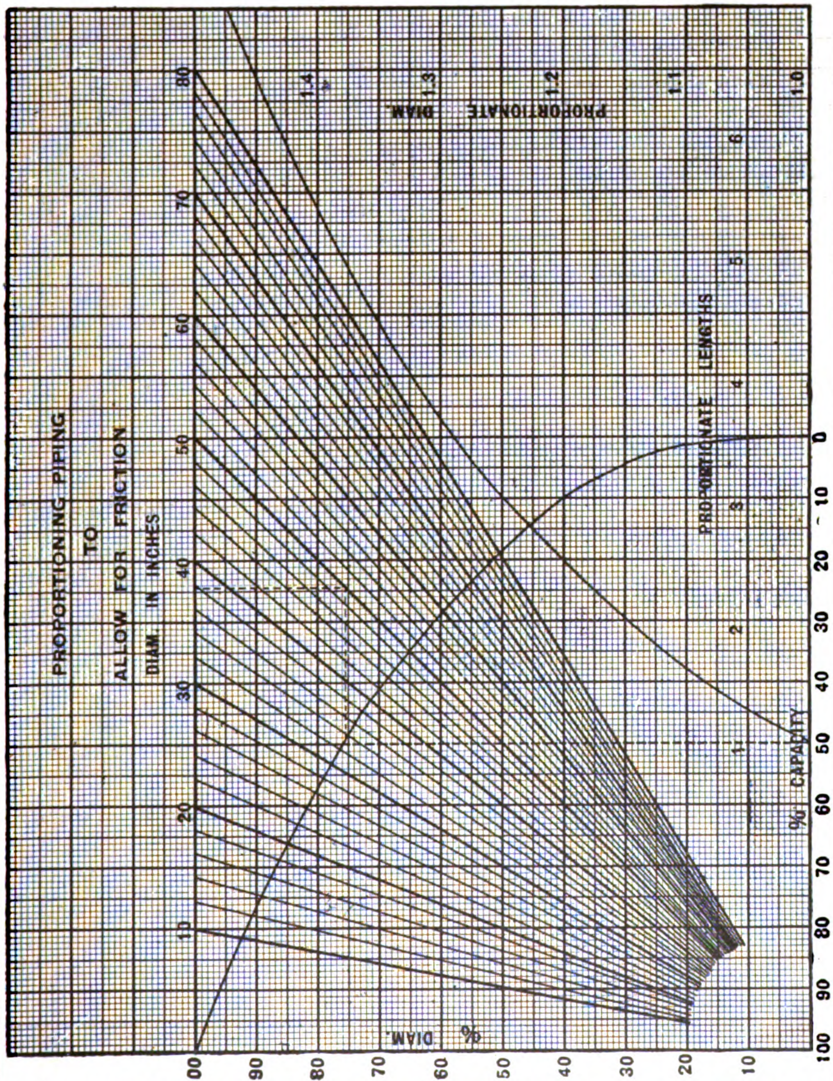


FIG. 1.—CHART FOR FIGURING DUCT AND FLUE SIZES ACCORDING TO METHOD NO. 6

SIZING DUCTS AND FLUES

METHOD NO. 6—Continued.

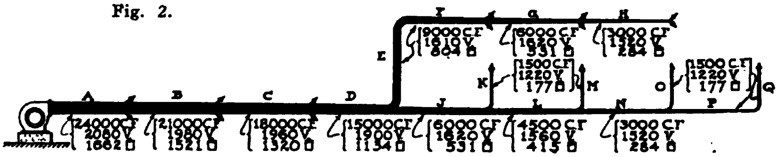
In public building work, individual ducts are recommended similar to those described in Method No. 2. For industrial buildings the sizing is developed from a chart which gives a constant friction drop in all lines regardless of size.

To use the chart, shown in Fig. 1, it is only necessary to determine the percentage of air delivered to each outlet and carried by each duct, together with the size of duct at the fan outlet; the sizes can then be read directly from the chart as follows:—

In the typical layout being used as an example, the total air is 24,000 cu. ft. per minute; allowing an additional 10% for losses in the system it is found from the chart that a No. 9 Niagara Conoidal fan is the proper size and that this fan has an outlet area of 11.81 sq. ft. The duct leaving the fan should have an area equal to, or slightly greater than the outlet; assuming, in this case, a 46-in. diameter duct (area of 11.54 sq. ft.), all the other sizes are determined from this basic size, these being governed by the percentage of air handled in each case.

The percentage of air for each of sixteen equal outlets is 6¼% per outlet and this gives the percentages for each case as shown in Fig. 2. For instance, after the first pair of outlets is taken off the main duct, 87½% of the air is left; finding 87½ on bottom of chart and following this up to the point where it intersects with the curve the percent of diameter may be read in the left-hand column (95%) 46-in. x 95% = 43.7-in., or 44-in. diameter duct. To read the size directly, instead of going to the left from the intersection go to the right until the diagonal line for the original flue size (46-in.) is met. Vertically above this second intersection may be read the size of the flue which will carry 87½% of the volume at the same drop as the 46-in. diameter duct (or 44-in.) which agrees with the size obtained by the longer method of multiplying the 46-in. diameter by 95%.

Fig. 2.

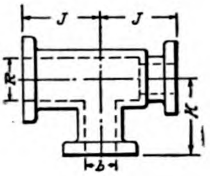


Continuing this method for the other percentages gives the duct sizes shown in Fig. 2, from which the velocities (when desired) may be computed, these being in this case as indicated.

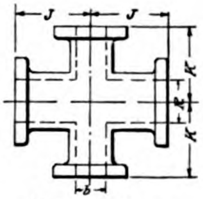
This gives a schedule of sizes as follows:—

Duct of Flue Mark	Quantity of Air C. F. M.	Proportion of Total P. C.	Diam. of Pipe Inches.	Area of Pipe Sq. Ft.	Velocity in Pipe F. P.M.
A	24,000	100	46	11.54	2080
B	21,000	87½	44	10.56	1980
C	18,000	75	41	9.17	1960
D	15,000	62½	38	7.87	1900
E-F	9,000	37½	32	5.58	1610
G	6,000	25	26	3.69	1620
H	3,000	12½	19	1.97	1520
J	6,000	25	26	3.69	1620
L	4,500	18¾	23	2.88	1560
N	3,000	12½	19	1.97	1520
K-M-O-P-Q	1,500	6¼	15	1.23	1220

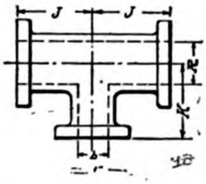
STANDARD BULL-HEAD REDUCING TEES AND CROSSES—FLANGED



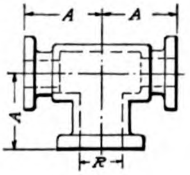
Reducing Tee.



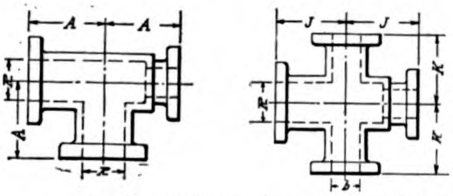
Reducing Cross.



Reducing-on-Run Tee.



Bullhead Tee.



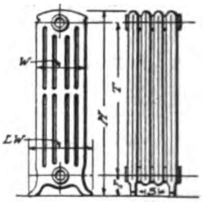
Reducing-on-Run and Branch Tee and Cross.

R	SIZE In. Diam. BRANCH "B"	DIMENSIONS, IN. A&J	K	Branch "b"	J	K	FLANGES Diam. In.	FLANGES Thickness In.
1							4	7/16
1 1/4	1 or less	3 3/4	3 3/4				4 1/2	1/2
1 1/2	1 1/4 " "	4	4				5	9/16
2	1 1/2 " "	4 1/2	4 1/2				6	5/8
2 1/2	2 " "	5	5				7	11/16
3	2 1/2 " "	5 1/2	5 1/2				7 1/2	3/4
3 1/2	3 " "	6	6				8 1/2	13/16
4	3 1/2 " "	6 1/2	6 1/2				9	15/16
4 1/2	4 " "	7	7				9 1/4	15/16
5	4 1/2 " "	7 1/2	7 1/2				10	15/16
6	5 " "	8	8				11	1
7	6 " "	8 1/2	8 1/2				12 1/2	1 1/16
8	7 " "	9	9				13 1/2	1 1/8
9	8 " "	10	10				15	1 1/8
10	9 " "	11	11				16	1 3/16
12	10 " "	12	12				19	1 1/4
14	12 " "	14	14				21	1 3/8
15	14 " "	14 1/2	14 1/2				22 1/4	1 3/8
16	15 " "	15	15				23 1/2	1 7/16
18	18 to 14 inc.	16 1/2	16 1/2	12 or less	13	15 1/2	25	1 9/16
20	20 to 15 inc.	18	18	14 " "	14	17	27 1/2	1 11/16
22	22 to 16 inc.	20	20	15 " "	14	18	29 1/2	1 13/16
24	24 to 18 inc.	22	22	16 " "	15	19	32	1 7/8
26	26 to 20 inc.	23	23	18 " "	16	20	34 1/4	2
28	28 to 20 inc.	24	24	18 " "	16	21	36 1/2	2 1/16
30	30 to 22 inc.	25	25	20 " "	18	23	38 3/4	2 1/8
32	32 to 22 inc.	26	26	20 " "	18	24	41 3/4	2 1/4
34	34 to 24 inc.	27	27	22 " "	19	25	43 3/4	2 5/16
36	36 to 26 inc.	28	28	24 " "	20	26	46	2 3/8
38	38 to 26 inc.	29	29	24 " "	20	28	48 3/4	2 3/8
40	40 to 28 inc.	30	30	26 " "	22	29	50 3/4	2 1/2

Note—A reduction in size *on the run* does not affect the dimensions but branch outlets of small size Such as are listed below will reduce the dimensions of fittings 18 in. or over in size.

H. B. SMITH CO.'S PRINCESS FIVE-COLUMN RADIATORS FOR STEAM AND WATER.

Sections	Total Length ft. - in.	HEIGHT, INCHES 37	25	16	14	12
		10 ft. per sec.	7 ft. per sec.	4⅔ ft. per sec.	4 ft. per sec.	3⅓ ft. per sec.
3	0 - 10¾	30	21	14	12	10
4	1 - 2	40	28	18⅔	16	13⅓
5	1 - 5¼	50	35	23⅓	20	16⅔
6	1 - 8½	60	42	28	24	20
7	1 - 11¾	70	49	32⅔	28	23⅓
8	2 - 3	80	56	37⅓	32	26⅔
9	2 - 6¼	90	63	42	36	30
10	2 - 9½	100	70	46⅔	40	33⅓
11	3 - ¾	110	77	51⅓	44	36⅔
12	3 - 4	120	84	56	48	40
13	3 - 7¼	130	91	60⅔	52	43⅓
14	3 - 10½	140	98	65⅓	56	46⅔
15	4 - 1¾	150	105	70	60	50
16	4 - 5	160	112	74⅔	64	53⅓
17	4 - 8¼	170	119	79⅓	68	56⅔
18	4 - 11½	180	126	84	72	60
19	5 - 2¾	190	133	88⅔	76	63⅓
20	5 - 6	200	140	93⅓	80	66⅔
21	5 - 9¼	210	147	98	84	70
22	6 - ½	220	154	102⅔	88	73⅓
23	6 - 3¾	230	161	107⅓	92	76⅔
24	6 - 7	240	168	112	96	80
25	6 - 10¼	250	175	116⅔	100	83⅓
26	7 - 1½	260	182	121⅓	104	86⅔
27	7 - 4¾	270	189	126	108	90
28	7 - 8	280	196	130⅔	112	93⅓
29	7 - 11¼	290	203	135⅓	116	96⅔
30	8 - 2½	300	210	140	120	100



DIMENSIONS

H = Total overall height.
T = C. to C. of tappings.
F = Floor to center of bottom tapping.
W = Width of radiator—12 in.
LW = Width of radiator legs—12 in.
S = Width of radiator sections, i. e., C. to C. of sections—3 1/4 in.

Nominal Height of Radiator	37-in.	25-in.	16-in.	14-in.	12-in.
H	37	25	16	14	12
T	30 3/8	18 3/8	11	9	7
F	4 5/8	4 5/8	3	3	3

Note: For legless radiators deduct 3 in. from H for 37 in. and 25 in. heights and 1 in. for 16 in., 14 in., and 12 in. heights.
For extra high legs add 1 in., 2 in., 3 in., or 4 in., to H. and F.
On all radiators extra high legs are special.

TAPPING DATA

SYSTEM	Size of Radiator Square Feet	Supply In. Diam.	Return In. Diam.
Steam, one-pipe	Up to 30	1	.....
	Over 30 up to 60	1 1/4	.....
	Over 60 up to 120	1 1/2	.....
	Over 120.	2	.....
Steam, two-pipe	Up to 50	1	3/4
	Over 50 up to 120	1 1/4	1
	Over 120	1 1/2	1 1/4
Water	Up to 50	1	1
	Over 50 up to 120	1 1/4	1 1/4
	Over 20	1 1/2	1 1/2

All air valve tappings are 1/8 in., those for water radiators being set at top.
All tappings with R. H. threads unless otherwise ordered.

THE HEATING AND VENTILATING MAGAZINE

Cooperstown, N. Y. September, 1918 1123 Broadway, New York

Burning Soft Coal in Heaters Designed for Hard Coal

With Suggestions for Selecting and Using Coal for House Heating Equipment.

In view of the fact that the middle western section of the country will only be able to obtain two-thirds as much anthracite coal for house-heating purposes as was used last winter, it is evident that a one-third deficit must be made up of bituminous coal from the mines of Illinois, Indiana and a small part of Kentucky.

There is special timeliness, therefore, in the suggestions that have been prepared by William H. Reid, smoke inspector of Chicago, which he recently promulgated under the title of "Suggestions for Fuel Conservation."

In selecting the coal Mr. Reid advises that the consumer should figure on purchasing at least 1½ tons of soft coal to be substituted for one ton of hard coal. The householder in buying soft coal for his bins, should select coal of the same size as the hard coal previously used. The size should not exceed 3-in. lumps.

FIRING SOFT COAL.

Soft coal, continues the statement, is a freer burning fuel on account of the gas it contains. For this reason hard and soft coals exhibit different characteristics when burning and should not be fired in the same way. Bituminous coal can be fired by placing the fresh charge on one side of the grate only, leaving a part of the surface of the fuel bed uncovered. The volatile matter arising from the freshly-fired coal is ignited by the red hot coal on the uncovered part of the fire and a large part of it burns in this way. This is called the coking method and is commonly used in firing square or rectangular fireboxes. The fresh coal is placed at the front end of the grate and the live coal pushed to the back part of the grate, replacing it with fresh coal in front, as the requirements demand. This process is repeated when the next charge of coal is added.

Another method successfully followed with circular grates, is that of placing the fresh charge of coal directly in the center of the grate and building up a pile in the shape of a pyramid with successive charges of fresh fuel. This method permits the coal to coke slowly and insures a mixture of the volatile smoke and gases which pass off from the fresh fuel with the hot gases from the coked coal burning at the edge of the firebox. This permits complete combustion with greater heat generation.

If the entire surface of the fuel bed, when burning bituminous coal, is covered with a heavy charge, the volatile matter from the fresh coal does not ignite for a considerable length of time after firing, and passes away unburned as tarry greenish-yellow smoke. The furnace and flues become filled with smoke and when the fire finally works its way through the fresh layer of coal, the smoke and gas may ignite with an explosion violent enough to cause damage. These explosions are more likely to happen with the finer grades of coal. Fine coal should be wet just before firing to prevent its being carried into the flues and chimney, also to prevent waste of this fuel by sifting through the grates.

The first mentioned methods of firing reduce the amount of soot deposited in the flues so that less frequent cleaning is necessary. They also economize the coal by reducing the heat losses from incomplete combustion and allow the heat to be transferred to the boiler direct. To attempt to burn anthracite coal from the side only does not work out successfully. It is necessary to spread this kind of fuel completely over the bed of live fire. Anthracite fires should be disturbed as little as possible.

On account of the characteristics exhibited in burning soft coal in house-heating equipment, it may be advisable during the mild weather to burn soft coal exclusively or else increase the proportion of this grade of the mixture. This will enable the householder to save the hard coal for the severe winter weather when the demands on the furnace are greatest. The two fuels can be mixed before firing or the soft coal can be thrown on the fire first and then covered with a layer of hard coal. Both methods have been employed successfully.

Fires should not be disturbed excessively and should be poked only enough to break up clinkers or coked coal. Ashes should be removed by shaking the grates and this should be done only enough to keep the fire clean and clear of ash; care should be taken not to lose good live coal in the operation. A thin bed of ash on the grates in moderate weather may prove economical, preventing the coal from burning up too fast. The ash pit should be cleaned out every day and ash not allowed to accumulate, as it interferes with the draft, sometimes causing the grates to burn up if allowed to clog the ash-pit, cutting off the air supply.

Air admitted over the fire is quite as essential to combustion of bituminous coal as the fuel itself, as it is necessary for the perfect combustion of the coal. A supply of air in large quantities is needed immediately after firing and this can be admitted by leaving the door above the fuel bed slightly ajar after each firing. When the volatile matter has been driven off the coal, the air supply through the door can be cut off. For this reason the burning of bituminous coal requires more careful attention and expert firing than hard coal or Pocahontas coal.

STARTING A NEW FIRE.

At the beginning of the heating season, before starting fires, see that the ash-pit, grates, tubes, and all gas passages, are clean, including connection between boiler and chimney. The precaution regarding cleaning of smoke pipe between boiler and chimney, should be rigidly observed, as there is danger of fire if soot is allowed to accumulate in this passage. If the proper cleaning of the flues and chimney is neglected, objectionable gases are generated in the furnace which find an exit through the fire door, filling the basement with smoke which arises to the living rooms above, creating serious as well as objectionable nuisance. It is especially important to have the boiler in a thoroughly clean condition as the bituminous or soft coals are smoky and cover the flue surfaces with a large amount of soot and tar which reduces the transfer of heat and impairs the draft.

Dampers should be adjusted so that they open and close properly and do not interfere with the draft in the chimney. It is very important that the ash-pit should be tight and the damper in the ash-pit door adjusted so that the minimum opening required to properly burn the fuel may be obtained. This damper should fit so that no air is admitted to the ash-pit when it is closed.

After banking fires, do not close the stack damper tight as the gas accumulates in the furnace and has no exit except through the firing doors, causing an accumulation of gas in the basement.

FINALLY:

Never fully close the damper in chimney connection.

Never let tubes, gas passes or smoke pipe become dirty.

Never leave clean-out door at bottom of chimney open.

Never make openings in the chimney for ventilating purposes.

◆

Burning Bituminous Coal in House-Heating Boilers

By W. A. PITTSFORD.

(From an address delivered at the Thirteenth Annual Convention of the Smoke Prevention Association, Newark, N. J., August 22, 1918.)

Regardless of what anyone may say, it requires more air in a given time to burn bituminous coal, than it does to burn the semi-bituminous coals that have commonly been used in the heating furnaces, that is to say, that at the moment of firing a great deal more air is necessary with a free-burning coal. After the volatile matter leaves the fuel bed, the carbon content of the fire is about the same with all coals, and requires practically the same air. The difficulty arises in the low-pressure heating of getting the combustion from the green fuels complete enough so that the tarry substances which form the soot do not adhere so rapidly to the boiler flues and surfaces, as to further close them up and stop the burning of the fuel.

GASES FLOW IN STRATIFIED STREAMS.

Gases in a furnace are not of uniform composition. They tend to flow through the combustion spaces in stratified streams. This tendency of stratification retards combustion, and is more prolific in hand-fired furnaces than in stokers.

Volatile matter leaves the fuel bed as complex, hydro-carbon compounds. In the absence of sufficient oxygen for their complete combustion, these hydro-carbons are quickly decomposed by the high furnace temperatures into soot, hydrogen and the carbon-monoxides. The formation of CO is due to the presence of CO_2 and the small supply of oyxgen. At a distance of 12 to 15 in. from the surface of the fuel bed only a very small amount of hydrocarbons can be found in any state, gaseous, liquid or solid. The solid substance present in flames is mostly soot with a trace of tar. All hydro-carbons are unstable at furnace temperatures, and unless enough air to insure complete combustion is quickly mixed with them at the time they are distilled, they are quickly decomposed, the remaining product consisting of soot.

Soot is formed at the surface of the fuel bed by heating the hydro-carbons in the absence of air, and it is not formed by the hydro-carbon gases striking the cooling surface of the boiler. As a matter of fact, only a very small trace of the hydrocarbon gases ever reach the surface of the boiler. The hydro-carbons that do so are prevented from decomposing by the cooling effect of this contact. The cooling

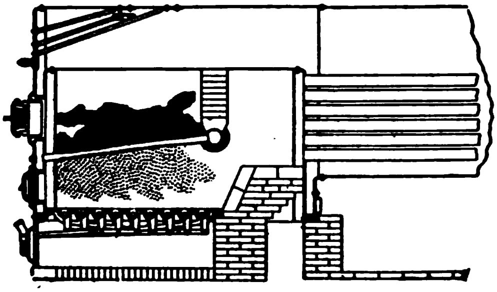


FIG 1.—STARTING A FIRE IN A DOWN-DRAFT BOILER.
Kindling is placed on the upper grate and lighted. The ash-pitdoor and the middle door are closed, and the draft door in the upper door left open.

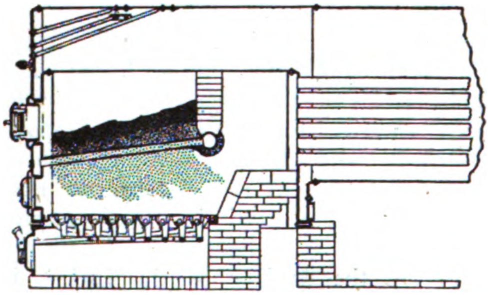


FIG. 2.—CONDITION OF FUEL BED AS BURNING PROGRESSES.
Draft door at top still remains open.

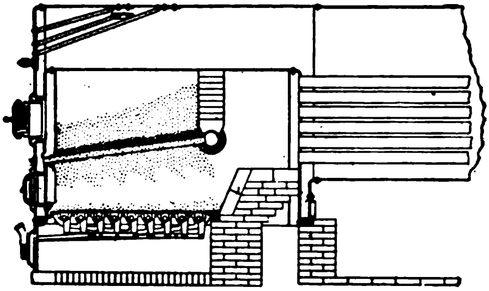


FIG. 3.—ENTIRE FUEL BED IGNITED.
Steam pressure is up and regulator has closed draft damper in top door.

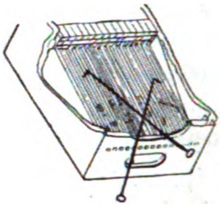


FIG. 4.—METHOD OF PREPARING FIRE FOR FRESH SUPPLY OF COAL.
One poker is used, the illustration showing the angles at which it should go under fire on top grate.

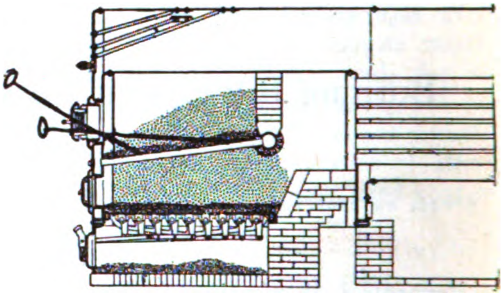


FIG. 5.—ANOTHER VIEW OF POKER GOING UNDER FIRE.
Showing way poker should go into door and shove along over top of grates back to end of grate.

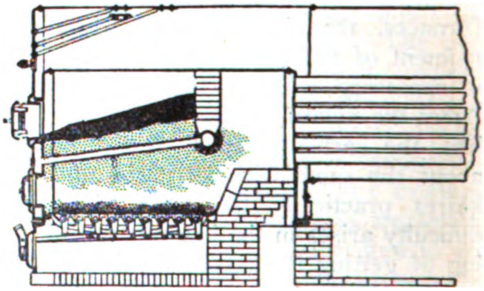


FIG. 6.—SAME FIRE WITH FRESH FUEL ADDED.
Air should now be admitted through bottom ash pit door to burn fuel on bottom grate.

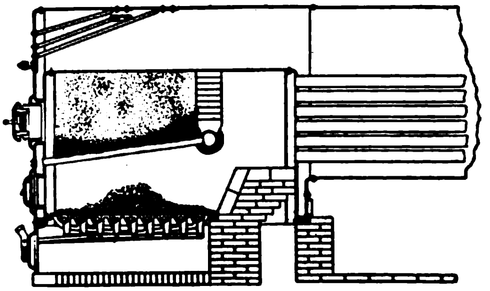


FIG. 7.—BAD CONDITION OF FIRE OFTEN FOUND.
Black portion on upper grate is clinker.

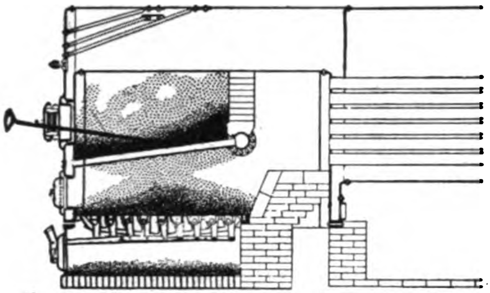


Fig. 8.—Manner of Attacking Clinker on Upper Grate.

Back portion of grate should be cleaned first.

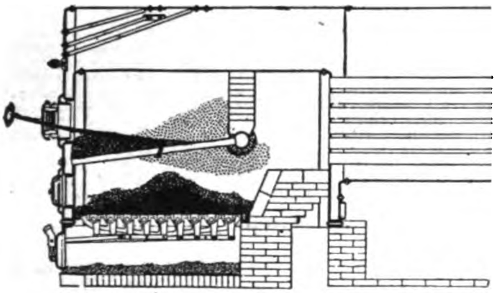


Fig. 9.—Rear of Fire Cleaned Out and Fuel Pushed Off Front Portion.

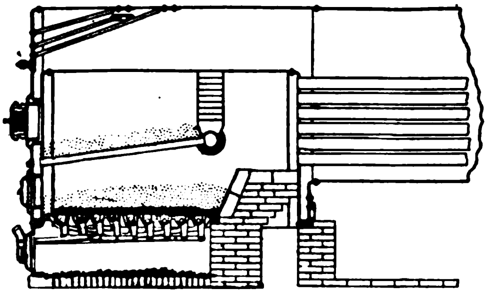


Fig. 10.—Fire Cleaned, Ready for Fresh Fuel.

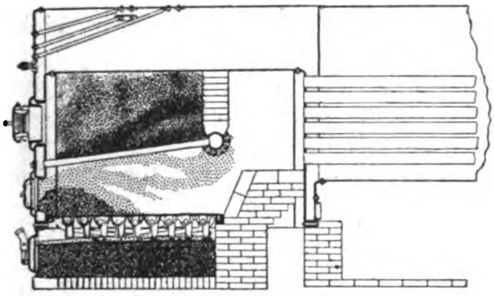


Fig. 11.—Another Prevailing Method of Improper Firing.

Front portion of upper grate bare, back portion covered with clinker.

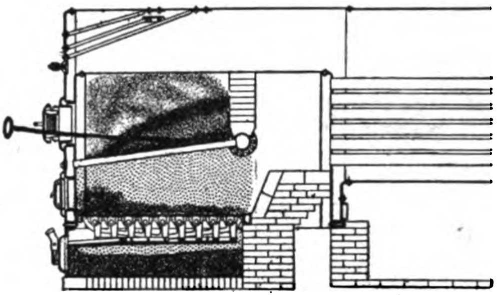


Fig. 12.—Method of Attacking Bad Case Shown in Fig 11.

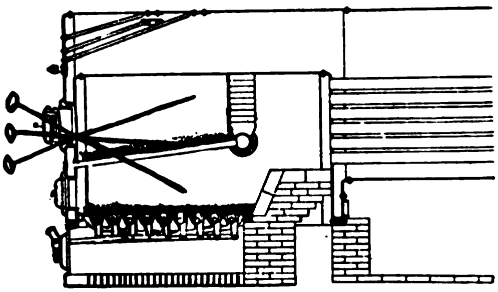


Fig. 13.—Improper Method of Using Poker on Down-Draft Grates.

This method breaks up fire and makes holes in fuel bed.

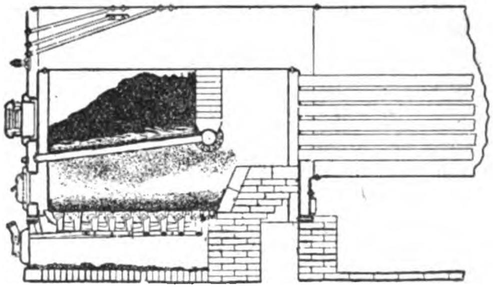


Fig. 14.—Fire Banked in Proper Manner.

Top door is shut by disconnecting regulator. Bottom ash-pit door openings left open.

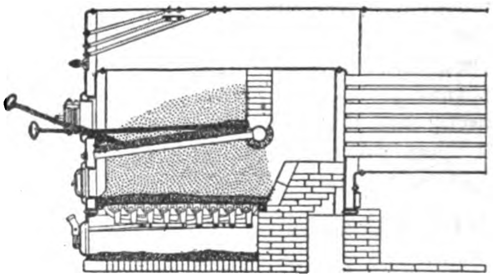


Fig. 15.—Condition in Morning When Banked Fire is Broken.

Poker to be used in manner shown, after ash accumulation is shaken into ash-pit.

surfaces do not cause the formation of soot; they merely collect soot and prevent its combustion.

THE MIXING OF OXYGEN WITH THE COMBUSTIBLE THE IMPORTANT FACTOR

The rapidity of burning combustibles in the combustion spaces depends on the quantity of oxygen intimately *mixed* with the combustible. The larger this quantity, the faster the combustible burns. Thorough *mixing* of the gases produces uniform mixture of the oxygen and combustible, thereby making possible the most rapid combustion with any given air supply. In many instances the rapidity of combustion is limited by the rate of mixing, and *mixing* is a very important factor in the attainment of complete combustion.

This means that in a heating boiler of the straight draft or updraft type, and using bituminous fuels, it is necessary when firing to leave a portion of the live, bright fire uncovered (this will not in these small units obtain complete combustion, but it will insure a better combustion) and in doing this you will necessarily force a better air mixture, a decreased supply of distillation, and with the low chimneys and low drafts that are always present in connection with heating furnaces, it will have a tendency to eliminate a portion, at least 40%, of the smoke and soot that otherwise would have been made and wasted. If the furnace is of such a design that some kind of an arch can be placed in it for a mixing effect, and the drafts are sufficient to take care of the load on the unit, then you can get complete combustion in this type of furnace. If the furnace can use an arch, then the other things necessary to its use must be changed so that the arch will be successful.

COAL SHOULD NOT BE LARGER THAN HEN'S EGGS.

Never fire large lumps of coal. They should never be larger than a hen's egg. In this way you will have a more even fuel bed, better distillation and better economy. You must break up the big lumps.

You cannot expect as good results with this changed condition and bituminous coal as you formerly had with hard coal or coke. You must expect to do more work, to attend to your fires more often and to be more particular with your fires in order to save a portion of the heat of this bituminous coal that you would otherwise have wasted, and in this connection we would suggest that the man who tends your furnace be given more money to do this work. If he was worth a certain price when coal was one-half the price it is now per ton, he should be worth more money when the price per ton is doubled, and the conditions are so unfavorable for operation.

WHY DOWN-DRAFT BOILERS ARE SMOKELESS.

Down-draft boilers are known in the heating world as smokeless boilers, and they are boilers equipped with a down-draft furnace. The furnace is what may be called a two-story affair, having two fire-grates, one above another. The upper is composed of pipes or other metal in which water circulates, and is a part of the boiler. The lower grate is an ordinary shaking or straight grate. The fire is on the upper or water grate and burns downward. The reason why this furnace is smokeless with all kinds of fuel is because the distillation of the green fuel must pass through an incandescent fuel bed of a very high temperature.

In the preceeding remarks on straight-draft furnaces, we dwelt on the fact that more free oxygen is needed at the time of firing than after the volatile gases are distilled off. Certain conditions in this down-draft furnace have worked out the very principles that we spoke of in the up-draft furnace. That is to say, when the green fuel is put on the incandescent fuel bed and the draft is down, the intimate mixture of the free oxygen down through the fire with the distillation passing through the fuel bed at the same instant combined with the high temperature of this fuel bed, forms complete combustion, and the rapidity of this combustion is governed by the amount of air allowed to pass through. If properly fired there can be no smoke. In the straight-draft furnace, it is absolutely necessary that the proper firing method be used to obtain the results desired. Likewise, in the down draft furnace the proper method of operation must be used to obtain the desired results.

NOTES ON USE OF SLICE BAR.

In a straight-grate furnace it is improper to use a slice bar and stir the incandescent fire, green coal and ash up together. Likewise, it is improper to do the same thing on a down-draft furnace. It is improper to do this with any type of furnace that man ever saw, and if people who have been using the very high carbon coals must use the high volatile coal, will give some attention to the proper methods of operation in the old type of furnace, they will not experience serious trouble in heating their buildings. They must not expect 100% efficiency from a furnace that is made to burn hard coal and coke when the subject it to the ordinary bituminous coals. They should not expect 100% efficiency from one in which they have placed an arch without attention.

From the beginning of time, all writers on combustion of coal and how to burn it, have always stated that to burn bituminous coal smokelessly and efficiently, it is necessary that the air be intimately mixed with the distillation of burning fuel at a high temperature, and many designs of hand-fired furnaces have been made to accomplish this result, nearly all of which had some feature about them that required a special addition constructed with the furnace to obtain a partial result of what they were designed to do.

DOWN-DRAFT CONSTRUCTION NEAREST APPROACH TO IDEAL FOR SMOKELESS COMBUSTION.

The man who perfected the down-draft furnace came nearer accomplishing this result than any other hand-fired furnace made. The fresh fuel is always placed upon a fuel bed from 4 to 10 in. deep. The draft admitted to this fire is through a door that is open to the atmosphere, the cold air passing through the green coal. As the coal is burning, the fresh air mixes intimately with the thousands of streams that are going through the hot fuel bed, giving you an intimate mixture that is not found in any other type of furnace in the world. If the furnace is built properly, with a proper boiler setting and a proper chimney to do the work that the boiler is called upon to do, there is no furnace in the world that will give you as near complete combustion as the down-draft furnace.

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Plain Talk on Chimneys

By E. C. LILLIE,
City Smoke Inspector, Denver, Colo.

The most important thing in house heating is the very thing that receives the least attention, and that is the chimney; and 99 out of 100 are far from right.

The failure of the chimney to "evolute" is incomprehensible, but I suppose it is another case of the "calf path" that determined the location of the beautiful streets of Boston. You spend weeks looking for a boiler while the builder is putting up a chimney that makes the use of a good boiler absolutely impossible. The height, shape, location, temperature and manner of construction govern the intensity of draft, while the area governs the volume of gases transmitted.

An excess of area is a poor substitute for lack of intensity and the lack of either one results in incomplete combustion or the use of higher-priced coal. Many chimneys of sufficient height and area are rank failures owing to loose construction, causing infiltration of air and checking of the draft. Talk about coal conservation! Were all the coal wasted during the last ten years because of poor chimneys now available, every mine in the country could shut down for a year and we would suffer no inconvenience and still the word chimney does not appear in our published rules to conserve coal.

Draft is not a suction, it is a case of push, pure and simple. While the pressure in the stack is slightly below atmospheric, it is so because of rarification due to expansion, which is in turn due to temperature.

VACUUM ARGUMENT MISLEADING.

The vacuum argument is misleading.

To illustrate. Assume a chimney containing 40 cu. ft. of air at 60° F. weighing about 3 lbs. Tightly close the chimney at the bottom, heat the air to 550°, causing it to expand until nearly one-half of the air runs over the top. Now the chimney is still full of air, but owing to the flow over the top the 40 cu. ft. now weighs but 1 6/10 lbs. On the outside of the chimney there are columns of 60° air weighing 3 lbs., the same as the air in the chimney before we heated it.

Now suddenly open the bottom of the chimney and we get the same result as we would with a balance with 1 6/10 lbs. on one end and 3 lbs. on the other. The 3 lbs. of cold air rushes in and pushes the 1 6/10 lbs. of hot air out of the chimney and thus the phenomenon we call draft is put in motion, and continues in motion as long as hot air or gases are supplied to it by a fire in the boiler or furnace. The outside air is the motive power, but if you shut up your boiler room so that the air cannot get in it cannot do the work. A 100-H. P. boiler requires about 150,000 cu. ft. of air per hour, or 2,500 cu. ft. per minute, and it cannot get in through a keyhole.

Water currents, air currents or gas currents take the way of least resistance, so if you have any cracks or openings through the side of your chimney the air is going through those and not through your fuel bed.

HOW TO BUILD CHIMNIES

Avoid this trouble by a sane type of construction. Lay the foundation of the chimney and place on it a round fire-clay flue lining, lay the brick up around it to the top of the lining. Then place another length of tile and lay the brick up, etc. Many of you have done this and been disappointed in the draft because the tile does not make a perfect joint and air leaks in; therefore, as soon as you get the brick up to the top of each joint prepare a batch of thin mortar containing a liberal percentage of cement and pour it in between the tile and brick till full; smooth up the joint inside and you have a chimney that is worth while, provided it is of proper size, height, location and straight from top to bottom. Size, 10 in. round for small houses, 12 in. round for eight or ten-room, and 15 in. round for larger. Why round? Because it is better, regardless of the opinion of your bricklayer.

Height.—As high as your wife or your architect will let you build it—thirty, forty or fifty feet above the grate.

Location—If you cannot build a house large enough to have room for a chimney, cut out building till you can, for you owe something to posterity. I know of nothing that will make them go wrong quicker than a draftless chimney.

We have a lot of tight-wad chimnies. In the effort to save a little space they stick them in an outside wall, run up through the lower edge of the roof and then blow about the architectural effect. Everybody is doing it. It is the style, like high heels, open fronts, etc., but if there breathes a man who is not fond of seeing things exposed to the weather, let him so locate the chimney that it can go straight up and emerge from the roof at its highest point, thus securing a good draft at all times. To place them at any other place and be free from contrary air currents they must extend so far above the roof as to be dangerous.

Offsets, contractions, etc. all restrict the velocities of the gases and should be avoided even to get around fireplaces. Why do I dwell so long on chimneys? Because they absolutely limit the possible efficiency of your heating plant and are the prime factor in the size of your coal bill.

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Remodeling a Candy Factory Plant to Reduce Condensation Losses

How Economies were Effected by Grouping Units According to the Temperatures Required.

The subject of how to take care of the returns and drips from steam apparatus and steam lines which are operated at different pressures is a fertile one for discussion. In many plants it has been the custom to discharge these returns into a common return line or receiver tank where a large portion is vaporized either in the return itself or after entering the vented tank into which the return line is connected. From this open tank they may be pumped directly into the boilers or allowed to flow into an open feedwater heater where they are re-heated. The increasing attention being given to obtain greater efficiency, the conservation of B. T. U. and the rising price of coal all combine to render a discussion of this subject a most profitable one. Is it, or is it not, correct to take care of such returns in this manner?

William H. Rose in a recent number of *The Sanitary Engineer* discusses this matter in relation to one particular plant although he states that "an examination of the conditions existing, the changes adopted and the results arrived at in any one plant may be taken as applying in the general way, with slight modifications subject to local conditions, to them all."

OPERATING CONDITIONS

The example cited is that of a candy factory upon which a complete record of facts and figures was obtained. In this plant the motive power is electrical and the entire output of the boilers goes to furnish heat for cooking, drying and heating in the factory. The industrial operations require steam at varying pressures so as to obtain temperatures ranging from 320° F. down to 215° which means pressures running from 110 lbs. (gauge) maximum down to about 2 lbs. minimum. The plant is supplied by three 150-H.P. H. R. T. boilers, coal-fired and operating at 115 lbs. The steam is piped directly from the boilers to the various apparatus. The condensate is drained through a variety of thermostatic, float and bucket traps, all of which discharge through return lines into an open receiver in the boiler room from which point the water is pumped into the boiler by a duplex steam pump.

Investigation showed a vent pipe discharging into the air (from the open receiver) which gave out a considerable amount of steam and vapor at all times. To keep down this amount of steam a stream of cold water was kept running into the receiver because it was stated the water came too hot to pump. This, of course, provided a superfluous amount of water which overflowed into the drain. The average temperature of the feed-water to the boiler was between 170° and 180°, whereas the returns averaged around 212° showing a direct loss of 37° between the receivers and the boilers.

The loss of water by actual measurement approximated 6½ gals. per minute which was a continuous loss while the boilers were in operation and represented over 1,000,000 gals. a year. The water came from the city mains at a temperature of about 45° F. while the overflow went into the drains at about 175°, thus carrying away heat to the extent of over 7000 B. T. U. per minute. This is equivalent to throwing away the B. T. U. obtained from almost a pound of coal or a loss of 60 lbs. per hour, or 600 lbs. per day.

The feed pump was operated continuously, and, at an average consumption of about 3% of the boiler power, used some 400 lbs. of steam per hour which, at an evaporation rate of 4 lbs. of coal per horsepower, is represented as 54 lbs. of coal per hour, or 540 lbs. per day. The steam was conducted to some of the apparatus at a pressure of 110 lbs. and was there condensed, this condensation occurring at 344°. Thus, when the condensation was allowed to cool down to 175° before it got back to the boilers it lost heat to the extent of 169 B. T. U. per pound, or approximately 17% of the heat necessary to make the steam. This can be checked by the fact that for every 10° increase in the feed-water temperature the fuel is reduced 1%. The amount of vapor lost through the vent pipe and by other means could not be accurately determined but was considerable. To avoid these losses the following scheme was adopted:

CHANGES MADE TO REDUCE LOSSES.

(a) Different units were separated into groups according to the temperatures required.

(b) The steam was taken direct from the boilers to the groups requiring the highest temperatures; i. e., full boiler pressure.

(c) After passing through these units the return condensate was taken through a swing check valve to a closed receiver.

(d) A drain line was run from the bottom of the receiver direct to the boilers, entering the boilers through a direct boiler-feeder which resulted in putting the water back into the boilers at about 300°.

(e) A vent pipe was taken from the top of the receiver, this collecting all the vapor and condensate which flashed back to steam due to the low pressure and conducting this lower pressure steam to the next apparatus requiring a lower temperature where the steam was used a second time.

The results obtained showed a saving of 1,000,000 gals. of water per year and approximately 564 tons of coal. There was also a marked increase in the quantity of material turned out and a big reduction in the time taken to complete the cooking process. The plant could be operated with two boilers instead of the three that were formerly required. The total cost of the re-arrangement of the piping approximated $1,000 while the water and fuel saving, taking water at 10c. per 1,000 gals. and coal at $4.00 a ton, amounted to $2,369.

HOW THE SIZES AND CAPACITIES OF THE BOILER-FEEDERS WERE FIGURED.

In figuring out the sizes and capacities of the different boiler-feeders they were approximated as follows:

The main boiler-feeder was arranged to have a capacity equal to the total horsepower developed at the boilers with a 50% reserve capacity. The high-pressure cooking units were estimated at about half the boiler load; the intermediate pressures at 30% and the low pressures at 20%. On this basis the losses and saving resulting from the changes work out as follows:

Boilers developed 450 H. P. which (at 30 lbs. of water per horse-power per hour) is 13,500 gals. of water evaporated; at 115 lbs. steam pressure the evaporation temperature is 347° and the latent heat of evaporation is 872 B.T.U. Thus the total heat of the steam is 1191 B. T. U. with feed water at 175° containing 143 B. T. U. To evaporate a pound of water into steam under these conditions requires the heat exchange equal to the difference of the two, or 1048 B. T. U. If a pound of coal gives 14,500 B. T. U. at 65% efficiency, each pound gives 9400 B. T. U. available and each pound of coal will evaporate 9400/1048 or 9 lbs. of water per pound of coal. Under the changed conditions about half of the water passed directly back to the boilers at 324° which, to evaporate into steam again at 115 lbs., requires only 897 B. T. U., or a saving of 151 B. T. U. per pound which is 15% on half the plant capacity. The 30% return came back at an average pressure of 60 lbs. and went direct to the boiler at about 300° or a saving of 12% on 30% of the plant. The low-pressure steam was returned at about 200° giving 2½% saving or a complete saving on the plant of

$$\begin{array}{r} 50 \times 15\% = 750 \\ 30 \times 12\% = 360 \\ 20 \times 2.5\% = 50 \\ \hline 1160/100 \end{array}$$

or a saving of 11.6% on the entire plant. This is on the temperature of the returns alone. In addition the reduction of steam demands caused by the elimination of the boiler-feed pump, using 3% to 5% of the total boiler steam, and the cutting out of the open vents on the system, it was estimated, reduced the boiler load and consequently the coal consumption at least 25%.

Savings Possible in Large Hot Water Heating Systems

Practical suggestions for effecting economies in the operation of large hot-water heating plants are made by the Public Policy Committee of the National District Heating Association. The suggestions are intended more particularly for central station heating work, but apply with equal force to any plant of considerable size:

With most hot water heating companies it has not been customary to reduce the schedule of heat temperatures at which the hot water is sent out from the station during the night hours and during the day when the sun is shining brightly. Inasmuch as most people prefer to have their houses cooler during the night than during the day; and in view of the custom of sleeping with windows open, it was thought advisable by one central heating station to reduce its schedule during the night hours during the past winter with the idea of conserving fuel. It was found by making the trial that the schedule at which hot water was sent out from the station could be reduced 10 degrees during the hours from 9 p. m. to 4 a. m. without any complaint from heating customers.

The reduced schedule resulted in a saving of 9,000 B. T. U. per 1000 lbs. of water circulated. This shows that during the period of seven hours per day in February, 1918, a saving of 22% of the B. T. U. supplied under the normal schedule was effected.

Also, it was further thought that a conservation of fuel by reducing the temperature of the water leaving the station during certain hours of the day when the sun was shining brightly might be effected. Experiments in this connection demonstrated that it was perfectly possible to send water out from the station at a temperature of ten degrees below the normal schedule between the hours of 9 a. m. and 4 p. m. on days when the sun was shining brightly without any complaints being received from heating customers. The effect of this reduction of temperature in the water sent out from the hot water heating station is similar to that effected by the ten degree reduction of the night schedule.

A great many buildings keep their steam heat on uninterruptedly during the twenty-four hours, and, in fact, some people are inclined to believe it to be the most economical way to operate a heating system. This, states the committee, is one of the popular fallacies which has perhaps been fostered by engineers who do not like the extra labor of pushing the fires in the morning hours. An example of what can be saved by careful manipulation of the valves is the Edison Building in Chicago, which last year had separate pipes run to certain offices which were kept open for the telephone operators and the load dispatcher's office all night long, and the balance of the building was turned off at night, leaving steam turned on in only 2% of the offices. The following tabulation will show the average mean temperatures in the winter months during the past winter and also during the winter before; the steam consumption during the corresponding months and the resultant number of hours of heating on account of the new method of handling the steam valves:

As will be seen, although the average temperature last winter was slightly lower than the winter before, there was a saving of about 25% in the steam consumption. This 25% saving was made without any appreciable discomfort to the occupants of the building. This same idea could probably be applied, with some modification, to residence heating.

In the report of this committee last year, reference was made to the enormous saving which could be made by adopting a lower average temperature for interiors than that commonly used, namely 68° to 70° F. This point has been emphasized during the past year by various government officials who have had charge of the conservation of coal. Articles by well-known physicians have been along similar lines, and while no definite action has been taken thus far, the general sentiment toward the maintenance of cooler interiors has undoubtedly increased.

	Mean Temperature		Steam Consumption		Hours Heating	
	1916-17	1917-18	1916-17	1917-18	1916-17	1917-18
	Deg. F.		Pounds			
October	54.4	45.0	4,424,000	3,261,000	491	405
November	43.2	32.0	6,175,000	4,065,000	592	354
December	26.0	22.4	8,751,000	7,515,000	730	450
January	24.2	13.3	7,985,000	7,470,000	737	380
February	19.8	27.2	6,842,000	4,853,000	672	302
March	38.8	42.2	4,953,000	3,859,000	599	297
April	44.8	44.0	3,769,000	2,776,000	570	278
May	52.6	63.7	2,443,000	305,000	490	31
Total			45,342,000	34,104,000	4,881	2,497
Average	38.0	37.6				
Reduction				25%		49%

CHICAGO COMMISSION ON VENTILATION

School Building Heating and Ventilation

By SAMUEL R. LEWIS

II

In the light of the foregoing observations, let us describe a school-house heating and ventilating system in which they are more or less intelligently embodied.

BOILERS.

These are in an outside fireproof boiler-house, and are capable of burning bituminous coal without smoke, carrying, say, 30 lbs. working pressure. They are steel encased, to prevent air infiltration. They are arranged so that at least 80% of the time there is a spare unit which can be shut down for cleaning or repairs. They have automatic high and low water alarms, and all other fittings as approved by the best engineering authorities.

ENGINES.

These are adjacent to the boilers and in a part of the boiler-house, but in a room free from coal and ash dust, while still under the observation of the fireman. They comprise fan engines, vacuum pumping and boiler-feed pumping engines, and a steam-driven air compressor. Steam power may be used also for driving air washer circulating pumps, hot-water circulating pumps, vacuum cleaners or any other power requirement. So long as there is any demand for heat, the power is very largely a by-product. These steam-driven engines are all provided with automatic governors, which are very simple and cause practically no trouble. Electric governors, on the other hand, are a constant annoyance. If the engines are arranged conveniently to the boilers, they can be very easily looked after, and transmission losses are minimized. It is highly desirable for ad-

FIG. 5. LINCOLN SCHOOL, TOLEDO, O.

ministrative reasons and on account of noise, to keep all mechanical apparatus as far as is practicable outside of the school building.

STEAM.

The steam at 30 lbs. pressure, from the boilers, passes to the various engines, and from them goes, via oil separators, to the low-pressure piping. It also reaches the humidifier, heating the water, if a washer is used, or being injected directly to the warmed air on its way to the building. There is a connection from the boiler-pressure mains directly to the low-pressure mains via an automatic pressure reducing valve, which, in any failure of the exhaust steam to maintain a predetermined pressure, say, 1 lb., will introduce live steam as required. Steam, if dry, at any pressure has a natural temperature corresponding to that pressure. That part of the steam delivered through the reducing valve will be at the lower pressure but at the temperature corresponding to the original pressure—in other words, it will be super-heated, this superheat tending to re-evaporate any free moisture in the exhaust steam.

VACUUM.

Each unit of radiation and each terminal of the steam mains has a connection into the return piping through a trap. The virtue of this appliance is that it will pass water and air, but will not pass steam. On the end of the return main at the boiler-house is a pump, steam-driven and automatically arranged to maintain on the pump side of the traps a constant pressure less than that on the steam piping. Thus all air valves are eliminated; the radiators heat all over very quickly; and the most distant unit is hot nearly as soon as the nearest unit. Cold water contains a considerable amount of air, which is liberated when the water is changed to steam, and we have constantly to remove this air from the system. The pump, therefore, delivers the air back to the open, and sends the hot water to the boiler-feed pump which returns it, still very hot, to the boilers. The circuit thus is closed, and little outside water need be introduced, saving in fuel and in deposition of impurities as scale.

AIR-WAYS.

The entering fresh air, from the cleanest available source, preferably high up in a vertical wall so as to void surface or roof dust accumulations, is warmed by indirect radiation to a temperature above freezing; is then washed, and moistened; and then warmed to about 70° F. The air washer is composed of a circulating pump, sprays, a series of eliminators, and a tank which collects all surplus water, and which supplies the pump. The dust in the air adheres to the droplets of water, or is slapped out of the air by the abrupt changes in direction, against the wet eliminator plates, is finally washed into the tank, and screened out of the water. The humidity of the air is controlled by varying the temperatures of the air and the water where they come in contact with each other. It is necessary, therefore, if satisfactory results are to be gained, to have tempering heaters on both sides of the washer, and in addition to provide a heater for the circulating water. If no washer is installed, the air is warmed to about 70°, then moistened by steam jets. It passes to the fans, which force it to the main distributing ducts. These are purposely very large, preferably of masonry, and are easy of access. They form in reality a long pressure chamber carrying the 70° air at slow velocity but considerable pressure—enough to balance, say, ¾ in. of water against atmospheric pressure at the most distant end. They have room for service pipes; are provided with lights, means for washing out, and are large enough for the attendant to walk through. They reach the base of every supply flue in the building. Anyone who has seen these large, clean, air

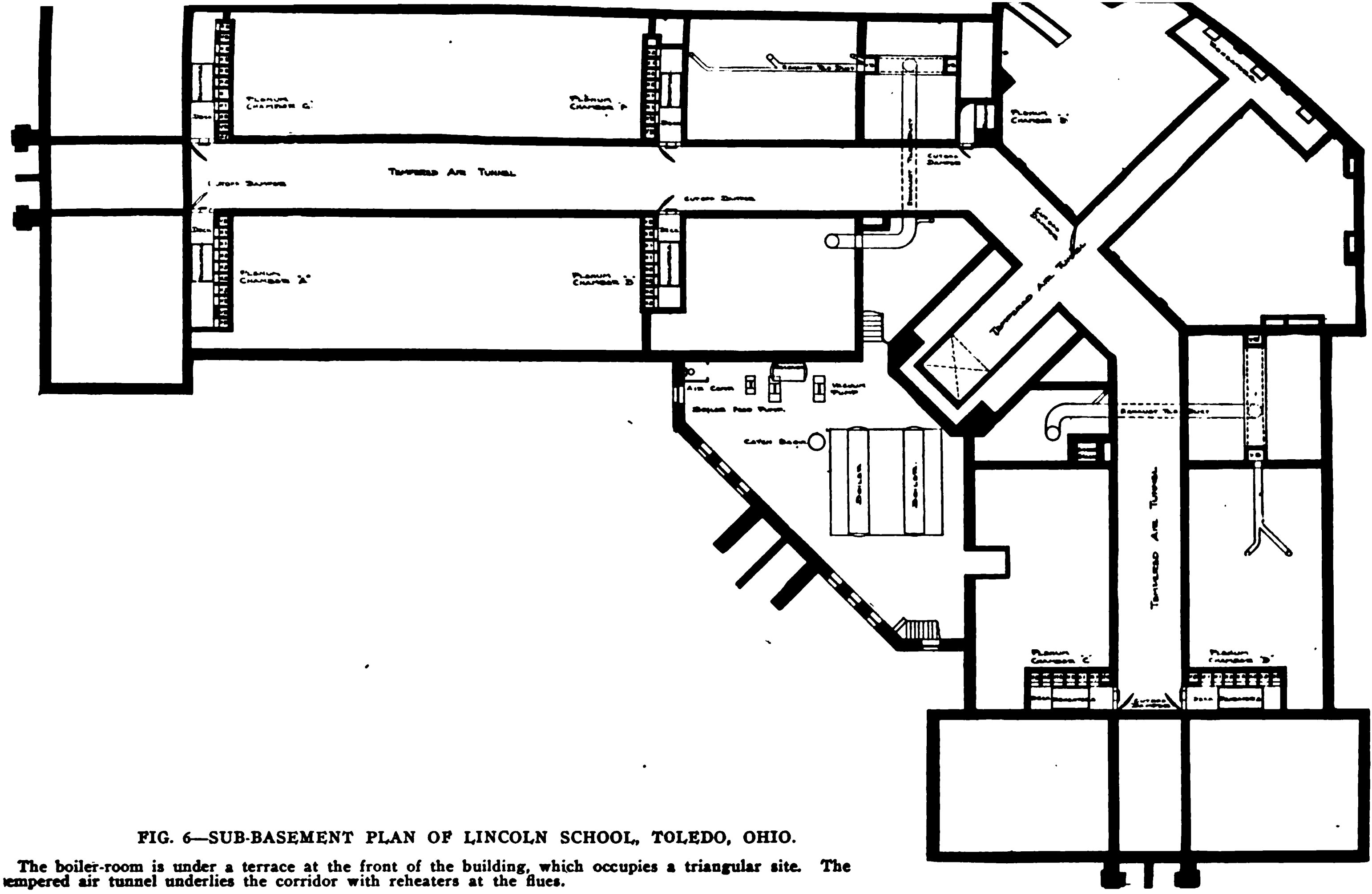

FIG. 6—SUB-BASEMENT PLAN OF LINCOLN SCHOOL, TOLEDO, OHIO.

The boiler-room is under a terrace at the front of the building, which occupies a triangular site. The tempered air tunnel underlies the corridor with reheaters at the flues.

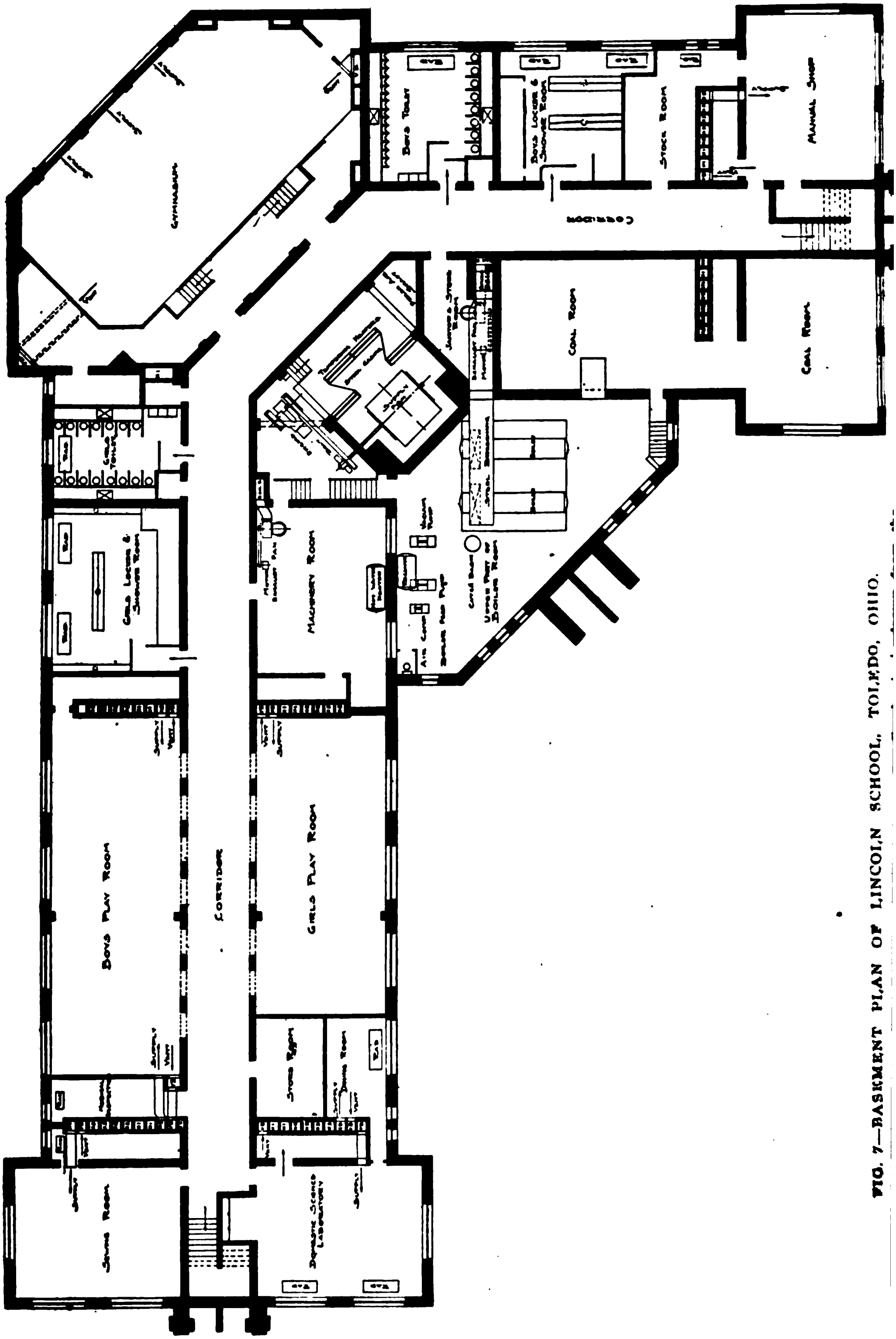

FIG. 7—BASEMENT PLAN OF LINCOLN SCHOOL, TOLEDO, OHIO.

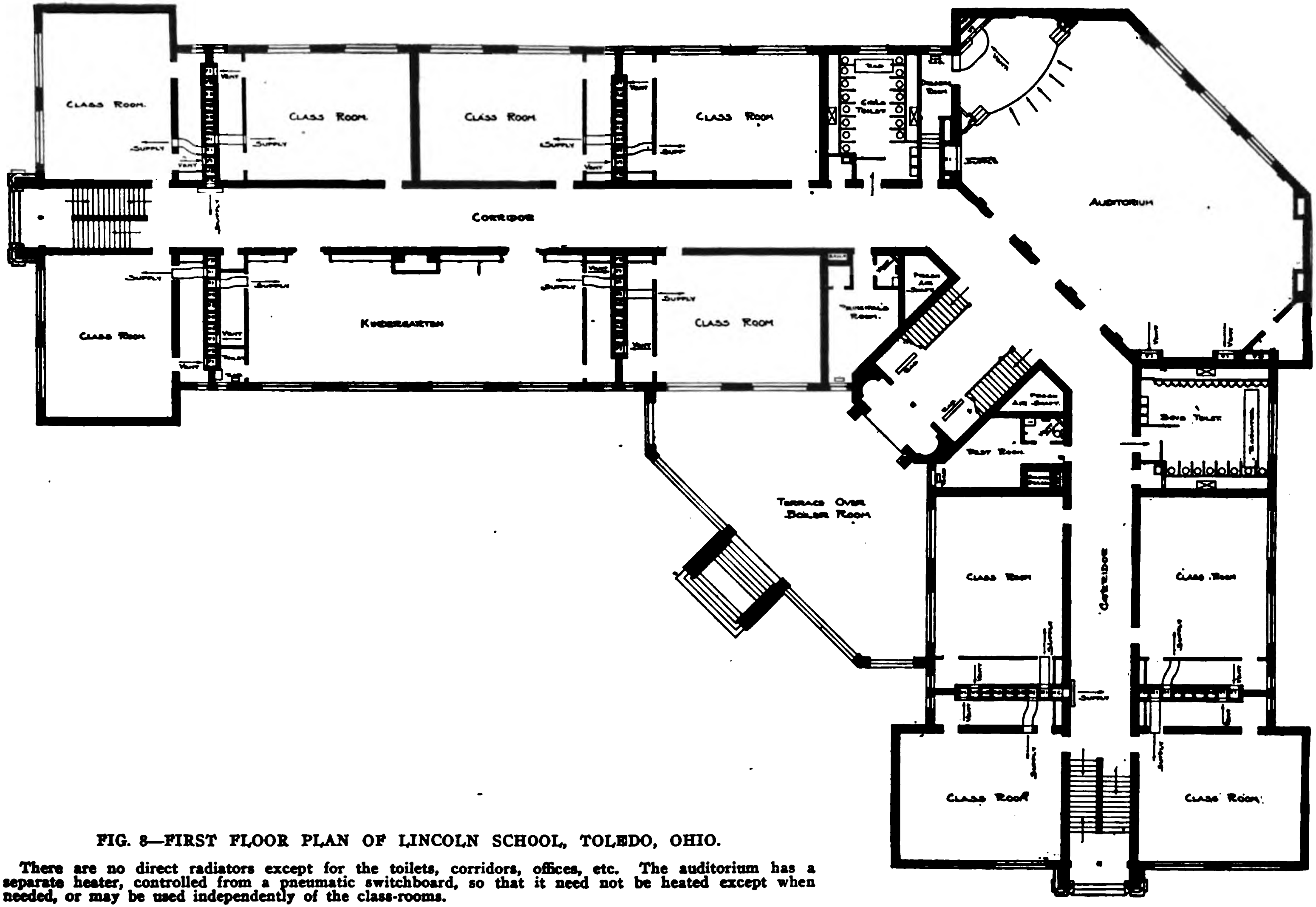

FIG. 8—FIRST FLOOR PLAN OF LINCOLN SCHOOL, TOLEDO, OHIO.

There are no direct radiators except for the toilets, corridors, offices, etc. The auditorium has a separate heater, controlled from a pneumatic switchboard, so that it need not be heated except when needed, or may be used independently of the class-rooms.

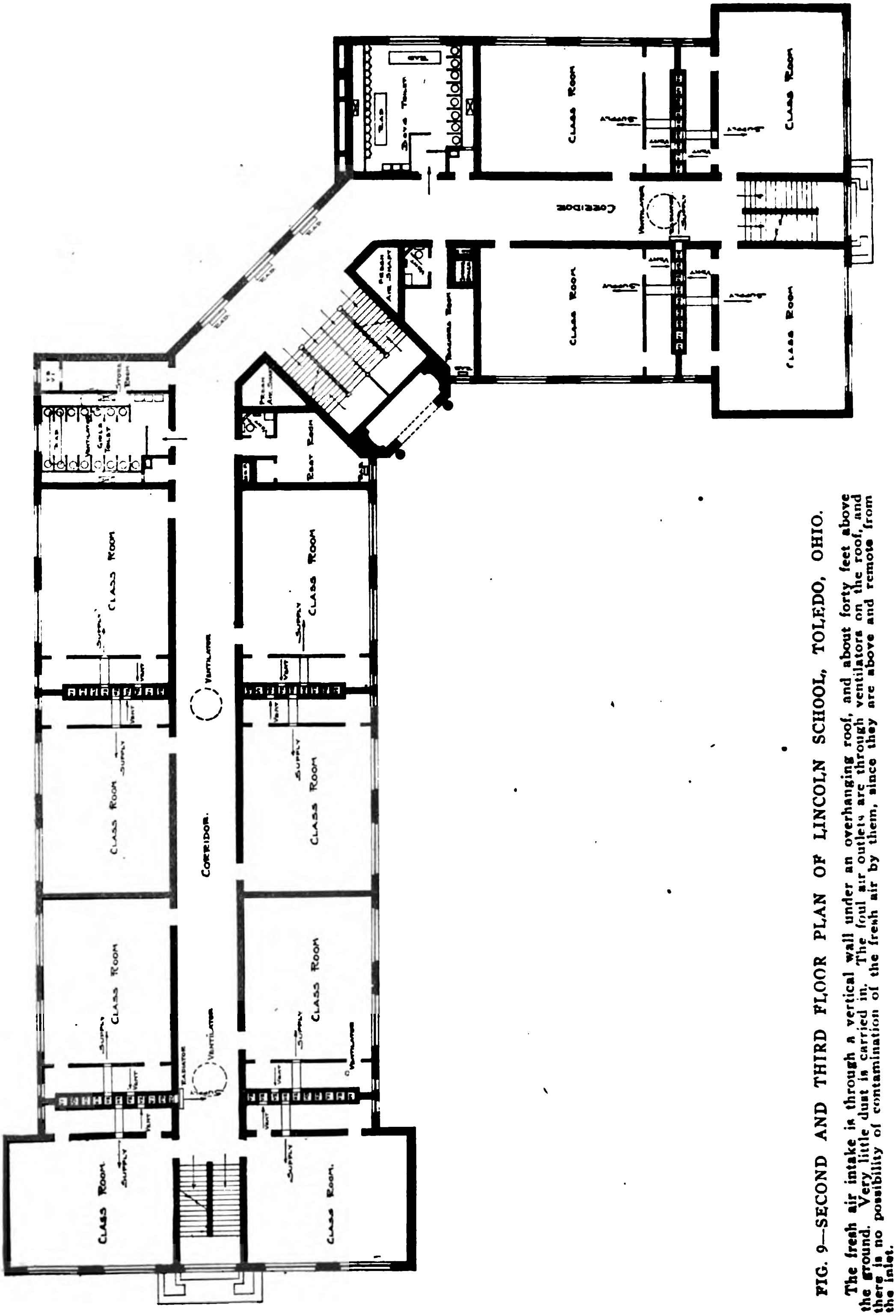

FIG. 9—SECOND AND THIRD FLOOR PLAN OF LINCOLN SCHOOL, TOLEDO, OHIO.

The fresh air intake is through a vertical wall under an overhanging roof, and about forty feet above the ground. Very little dust is carried in. The foul air outlets are through ventilators on the roof, and there is no possibility of contamination of the fresh air by them, since they are above and remote from the inlet.

ducts and who has compared them with the uncleanable and inaccessible metal ducts usually provided, will testify as to their superiority.

HEATERS.

From the comparatively slow speed and high static pressure of the air-ways, the fresh air passes into the flues through mixing dampers operated by thermostats automatically, and through volume dampers, hand-adjusted, both located at the flue bases. When the rooms are cooler than the point at which the thermostats are set, the air is not permitted to pass the cool air part of the mixing damper, but rises to the hot air part of the mixing damper (Fig. 10), through steam radiation of sufficient capacity to furnish the heat lost via glass and walls. The heated air rises directly into the rooms, and is not conveyed horizontally any appreciable distance after it has been heated. If several flues happen to be adjacent, the heaters may well be combined so that after any one of the rooms has become warm and has its warm air mixing damper closed, the heating surface provided but now not required for that room, instantly and automatically serves all the rooms in that group which are still cool.

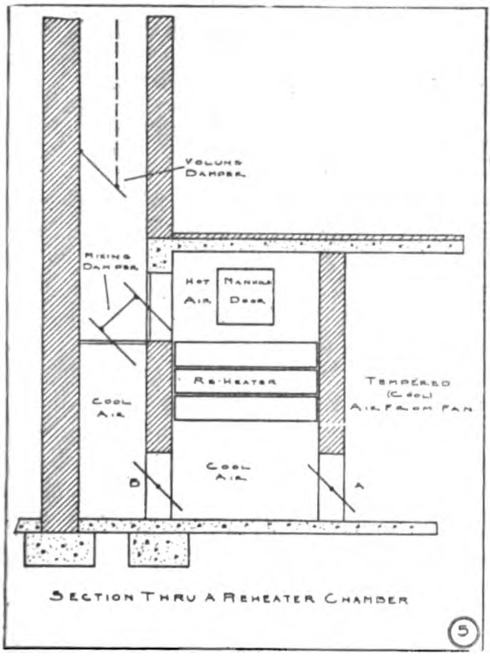

Fig. 10. This reheater supplies seven rooms, through seven flues, only one of which is shown in the cut. Damper "A" is controlled by a pneumatic switch in the engine room, and may be closed when for any reason the seven rooms are not to be heated. Damper "B" is for cumulative heating and is, with similar dampers in the cool air entrances to all other flues, operated by a pneumatic switch in the engine room. The mixing dampers admit a constant volume but varying temperature of air to the flue, controlled by the thermostat in the room served by the flue. The volume damper is hand-controlled and when once adjusted is never moved.

The resistance to air travel interposed by these heaters, mixing dampers and volume dampers, is relied upon to enable us to maintain a high static pressure in the main air-way. As soon as the air leaves the air-way and enters the flue above the dampers, it is under very much less pressure and its velocity decreases. This arrangement is designed to permit the free opening of windows in any rooms without affecting other rooms, for if the pressure in a room is increased by open windows it means that in all probability plenty of fresh air is entering the room and little, if any, air will enter through the regularly appointed supply flue. Yet there is no danger of this pressure backing down the flue, through heaters and dampers, and having any particularly objectionable effect on any other rooms against the high-way pressure. If, on the other hand, the room is on the lee side, and the pressure in it on opening the windows becomes less than normal, then the flue hastens to furnish fresh air due to the drop in resistance pressure, but this increase is of no particular effect on the other rooms, since the main air-way static pressure tends to be maintained in any event by the throttling resistance at the heaters and dampers.

AIR DELIVERY.

Since the air is not heated above 70° F., until it arrives where it is wanted, with a fair steam delivery system, the most distant room is heated as readily as the nearest room. Until the room is warm, of course, the entering air will

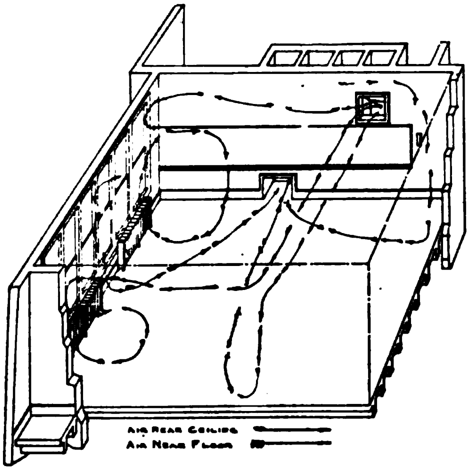

FIG. 11 The air currents are affected by temperature, falling near the glass, rising near the radiators, neutral in some spots, rapid in others. When the entering air is warmer than that in the room, the fresh air stays at the ceiling; when cooler, it falls to the floor at once.

be at a temperature which, depending on the movement of the mixing dampers, may reach 110°. This, however, is of no more serious effect on the vital quality of the air than if we had direct radiators in the rooms, for with the slower air passage of the much greater hot surface of the direct raditors, the air the radiation at the flue bases, having the air sprayed through it at high speed, wiping the heat constantly away, we can do do with 33⅓% of the radiating surface which would be necessary for any room in direct radiators placed in the rooms. The air, warmed and conditioned as necessary, then, is delivered into the rooms. If it is permitted to be introduced more than around 10° cooler than the air in the rooms, no matter where or how it is entered, it causes discomfort. The usual method of introducing the air near the ceiling at low speed as shown in Fig. 11, and toward the glass is proven under ordinary conditions, to be very inefficient. There is marked lack of air movement at many points in the room, and unduly high movement at others. The dilution is very uneven. It is quite clear, in fact, that the dilution of the old air with the fresh air is not an easily maintained process, and that to achieve ventilation we should abandon any schemes which depend on dilution for their success. We can probably achieve fair ventilation by dilution only while we operate numerous local fans in the rooms which accomplish the dilution mechanically, after the manner of an egg-beater. We have observed, however, that in any heated room the warmer air will be at the ceiling and the cooler air at the floor.

BEST METHOD OF INTRODUCING AIR.

The simplest and easiest adaptation of the usual building construction, we believe, is to introduce the fresh air at the highest speed commensurate with considerations of comfort and sound, at a tagent to the largest circle which can be inscribed in the room, at a vertical point over the heads of the occupants, with the outlet at the floor. The location of the outlet in plan, with reference to the inlet in plan, seems to be of small importance, but the outlet, we believe, is best placed in an interior partition near the cool walls, as illustrated in Fig. 12. With his arrangement a corkscrewlike movement of the air, and a general whirling effect of the entire room air content, is achieved,

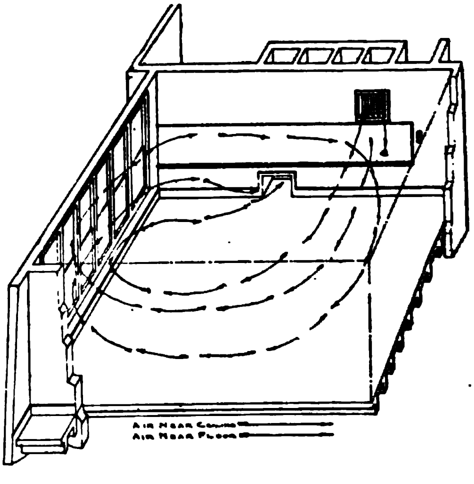

FIG. 12. The tendency of the cool walls and glass to cause the air to approach the floor is used, in connection with the horizontal current due to fan pressure, to achieve a corkscrew or spiral circuit from inlet to outlet.

wiping away the aerial envelope from the bodies of the occupants and giving the desirable summer breeze simulation. Ventilating flues should never be placed in outside walls, unless they are very perfectly insulated. The increase in weight due to cooling the escaping air, and the leakage in from outside, tend to render outside wall vent flues of very small value.

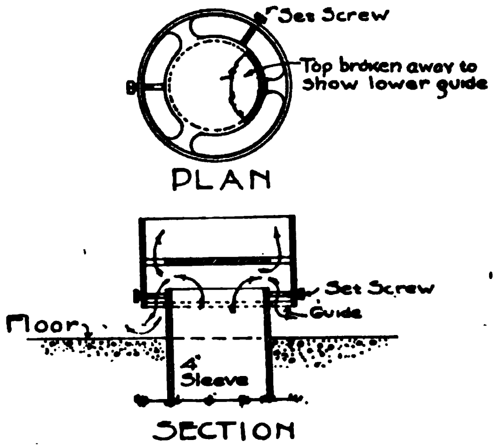

FIG. 13—HOOD FOR FLOOR INLET.

The foregoing applies to class-rooms having up to fifty pupils each. For other rooms which have special requirements or furniture, more efficient arrangements are made. For auditoriums, for instance, no air handling scheme yet devised equals the upward system, from an air chamber under the floor, with hooded openings under each seat (Fig. 13), the air movement being upward over the bodies of the occupants and directly to ceiling outlets. By no other ventilating device of which we are cognizant, is it possible to prevent an unduly high temperature in the galleries of a lofty room, and in our opinion with upward heating and ventilation it is unnecessary to compensate by increasing the temperature of the entering air for the heat lost through the ceiling and upper parts of the side walls. It is, however, especially necessary to provide for condensation on the upper walls and glass, since the temperatures are so much lower at these points than with any other type of heating system. Skill is required in designing upward systems, to obtain even air distribution, and the inlet velocities must be low, probably not exceeding 150 linear feet per minute. Care must also be exercised in operating such rooms to prevent any sudden variations in the temperature of the entering air due to the intimate contact with the occupants.

VENTILATION FOR GYMNASIUM AND SIMILAR ROOMS.

For gymnasiums and similar rooms, the air will be introduced through the window sills (Fig. 14). The openings may be narrow, and as long as the windows are wide. The air is delivered vertically, and tends to give the same distribution efficiency in the rooms as would be obtained if the windows were opened. Radiators in gymnasiums are most objectionable, because of the obstruction they offer and because of danger of burning persons; but the advantage of radiators may be gained by furring around them with tile or metal,

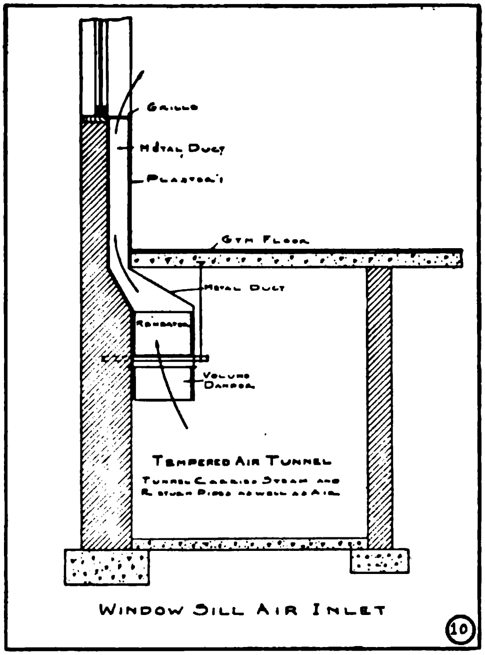

FIG. 14—WINDOW SILL AIR INLET.

and blowing the air supply up through them, with long, narrow inlet registers above the radiators, in the window sills or elsewhere. About one-third of the radiating surface will be required where so arranged, as would be required for common direct radiators. It is highly desirable that lofty rooms often without attic spaces under their roofs, have air outlets at the ceilings as well as at the floors, particularly for use in warm weather, or when using the ventilating system as a cooling apparatus.

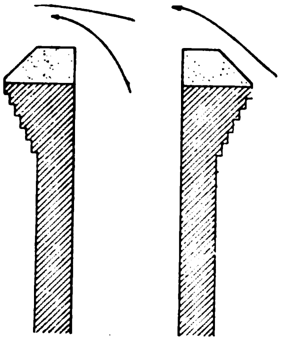

FIG. 15—APPROVED CHIMNEY TOP.

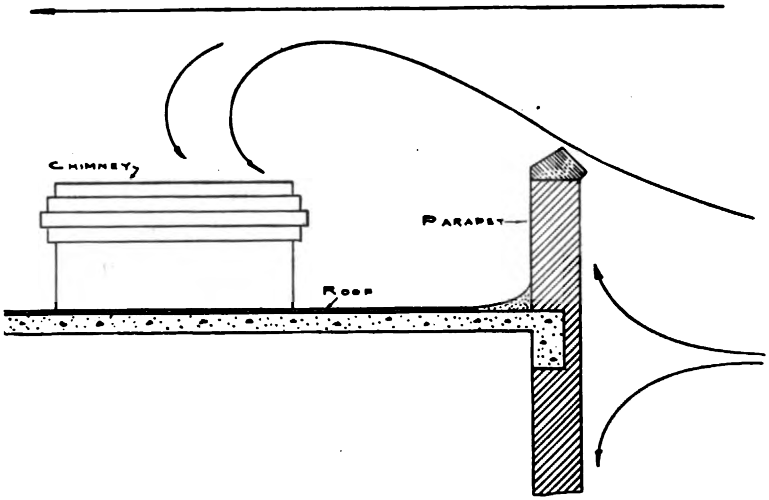

FIG. 16—WIND EFFECT ON A LOW CHIMNEY.

For domestic science rooms and the like, the ordinary ventilating plant will be supplemented by local electric-driven, exhaust fans, operated by the instructors with push-buttons when necessary for eliminating odors or high temperature air. Such apparatus positively will prevent odors being transmitted outside of the rooms in which they originate.

EXHAUST VENTILATION FOR CHEMICAL LABORATORIES.

The exhaust arrangements for chemical laboratories must take into consideration the products which are heavier than air, and in general all chemical vent outlets should have both up-draft and down-draft facilities. The usual overhead hoods are generally ineffective unless an excessive volume of air is handled.

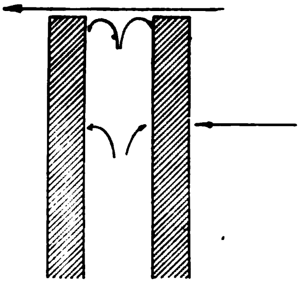

FIG. 17—IMPROPER CHIMNEY TOP.

OUTLETS FROM BUILDINGS.

The separate exhaust fans each have an independent outlet through the roof, arranged so as not to contaminate the fresh air supply. This is generally possible of accomplishment when outlet and inlet must be anywhere near each other by extending the outlet chimneys higher than the fresh-air intakes. Since a heated building is like a hot-air balloon, and the warm air asks nothing better than to be permitted to escape, there seems no especial need of exhaust fans except for removing odors or aiding in cooling some unusual room. The type of roof outlet, however, has a very marked effect on the operation of the plant. Tests have established that an open chimney with a bell around its top which tends to deflect any horizontal wind currents upward, is more effective than anything else, and that the usual ventilator hoods are measured in efficiency by how much rain and snow they keep out while interfering least with the air passage (Figs. 15, 16 and 17). In general, circular ventilator hoods are better than narrow rectangular ones. Always the outlets, unless of the pivoted type, must be open all of the way around. A ventilator not open all around becomes a funnel when the opening is to windward, and no fan pressure used in ventilating plants can compensate for wind pressure down such a funnel. No side wall vent outlet from a building, therefore, can be depended upon. Long, narrow outlets in the ridge of sloping roofs are very effective, and may be open on top, with gutters in the attic to catch the rain and snow (Fig. 18). We have no instances of such outlets causing any trouble, when properly designed. The escape of heated air when the building is not occupied is prevented by dampers pneumatically operated from the engine room.

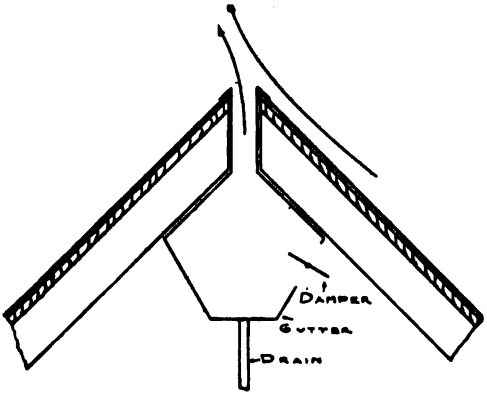

FIG. 18—AIR OUTLET IN RIDGE.

ROOF CONSTRUCTION.

The skylights, where possible, will be guarded from condensation trouble by having the dry, warm air from the building pass under them on its way out. If this is not possible, there must be provided proper steam coils to keep the air which comes in contact with the skylights above the dew point temperature.

SPECIAL STEAM MAINS.

The offices, toilets and rooms having plumbing fixtures are heated by radiators which are supplied with steam from a separate main to that used for supplying the balance of the building, so that these rooms may be kept warm economically at times when the ventilating plant is closed down.

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A. S. ARMAGNAC....................*President*
GUSTAVE PETERSEN....*Secretary and Treasurer*

A. S. ARMAGNAC, Editor
GUSTAVE PETERSEN, Business Manager
HAROLD L. ALT, Contributing Editor

European Representative:
W. G. HOLLINWORTH, 304 High Holborn
London, W. C.

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IN PRESENTING this "Fuel Conservation Number" to the trade we feel that it is not only a fitting wind-up to the part taken by THE HEATING AND VENTILATING MAGAZINE in the Trade Extension Campaign, but that its contents, including the suggestive announcements of our advertisers, may easily prove of far-reaching value in the impending fuel stringency. One more step, however, is needed to make the effort a complete success and that is the unbiased and energetic co-operation of our readers. Heating engineers are often considered biased in their devotion to favorite methods and appliances and while this may often be a good fault it is likely to leave one behind in these days of stupendous world movements and developments.

Engineers and contractors always owe it to themselves, no less than to the trade they represent, to acquaint themselves with the latest developments in fuel-saving apparatus and appliances, but just now, when the coal situation is about to again become a national problem, they are confronted with a very grave responsibility, as well as an opportunity, of doing much more than their share in saving that extra shovelful.

From a commercial standpoint, the trade may well congratulate itself on the turn of events that has placed the science of heating at the very forefront of activities connected with the war. There has been some question as to whether general building work could be called an essential industry, but when it comes to the remodeling of existing buildings and the installation of fuel-saving equipment, this work already has the right of way and will go far towards keeping the industry on its feet during the war period.

◆

THE QUESTION has often been asked, why are heating engineers provincial in clinging to their own views and methods? One answer is that they are not. But to a large extent it is true that there is less open-mindedness than there should be. It used to be said that the cause was the comparatively narrow field and the fact that heating is not an exact science. The field itself, as everyone knows, has been expanded to such an extent as to give it a definite place as one of the major industries. Progressive men in the trade are fully awake to this fact and are keen to hear of all the new appliances and to assure themselves of their merits. Most of our readers, we are confident, are included in this class and they will never have a better opportunity than right now to assume a position of leadership in their profession.

Latest Advices on Next Winter's Coal Situation

In order to obtain the latest rulings of the United States Fuel Administration on the outlook for the supply of anthracite coal for house-heating purposes during the coming winter, The Heating and Ventilating Magazine addressed a letter to the Fuel Administration asking for a statement on the subject. In reply, dated August 14, 1918, A. S. Learoyd, director of the anthracite distribution for the Fuel Administration, makes the following statement:

"The Fuel Administration has not made any ruling or order as to the proportion of coal to be allotted to householders during the coming winter. I think I can best get the whole matter before you by sending you a copy of the order of the United States Fuel Administrator covering the local distribution of coal this year.

"With particular reference to anthracite, it is felt that the allotments made in New England, New York State, Pennsylvania and New Jersey, Maryland, Delaware and the District of Columbia are sufficient to cover 100% of the minimum needs of the domestic consumer.

"Anthracite has been eliminated this year entirely south of the Ohio and Potomac Rivers, excepting in Virginia where the allotment was approximately 40% of the actual tonnage of 1916 and it has also been eliminated in the States West of the Mississippi, excepting the upper portion of Iowa, Minnesota, North and South Dakota.

"The tonnage to the central states like Illinois, Indiana, Ohio and Michigan has been materially reduced from the tonnage shipped in 1916.

"Eliminations and reduction were necessary in order to provide for the minimum needs of the notheastern section of this country, where only anthracite coal is available for domestic consumption."

Details of Coal-Distribution Order

The order referred to by Mr. Learoyd is known as Publication No. 19 and is entitled, "Regulations of the United States Fuel Administration Regarding the Retail Distribution of Coal and Coke for the year 1918." The full text of the order follows:

The United States Fuel Administration recommends and encourages the purchase and storage of coal and coke for necessary domestic requirements as early as possible in order, first, to insure the delivery of coal and coke for this purpose, and, second, to assist the transportation companies by effecting delivery of as much coal and coke as possible before next winter.

The following general plan has been adopted governing retail distribution for 1918. Conditions differ so widely in different localities that no attempt is made to provide for every contingency and the State Fuel Administrator is authorized to make certain modifications as indicated in the regulations hereinafter set forth when necessary to meet local conditions:

I. Every consumer should be urged on or before April 1, 1918, to place with his regular dealer his order for his reasonable normal requirements for the year ending March 31, 1919. Such orders must be made in writing and must state substantially the information called for in regulation (*c*) hereinafter set forth. When such orders have been entered, the dealers shall proceed to make deliveries thereon, until each consumer, willing to accept the same, has received two-thirds of his normal annual requirements, provided that orders of 6 tons or under may be filled in full. When all consumers, who are willing to accept it, have received two-thirds of their normal annual requirements, the dealers may proceed to fill the balance of such orders up to normal annual requirements of each consumer. (*The provision for two-thirds delivery should apply only to anthracite. With respect to bituminous for domestic use, the dealer may procaed to deliver the consumer's normal annual requirements.*) If a consumer already has a quantity on hand, he shall receive only such additional amount as shall make up his normal annual requirements.

New consumers who are unable to have their orders accepted by a dealer should apply to the local fuel administrator, who should see that their requirements receive attention from the proper dealer. Carload or bargeload lots shall not be delivered to a single domestic consumer or to a group of consumers except with the permission of the local fuel administrator. Dealers shall file with the local fuel administrator on the first of each month a statement containing the names and addresses of consumers to whom deliveries have been made during the previous month and the quantity delivered to each.

II. The following regulations have been established by the United States Fuel Administration:

(*a*) Until further notice no domestic consumer of coal or coke shall purchase, receive, or otherwise take possession of, more coal or coke than is required for his actual and necessary requirements prior to March 31, 1919. If such consumer already has a quantity on hand he shall receive only such additional amount as shall make up his actual and necessary requirements prior to that date.

(*b*) No person, firm, association, or corporation, whether acting alone or in conjunction with others, shall, directly or indirectly, provide any domestic consumer of coal or coke with more coal or coke before March 31, 1919, than is necessary, with the amount already on hand, to meet the actual and necessary requirements of such consumer prior to that date.

(*c*) On and after April 1, 1918, no person, firm, association, or corporation shall sell or deliver coal to a domestic consumer who does not first furnish to the person selling or delivering such coal a statement which the consumer declares in writing to be true, and which specifies (1) the amount of coal the consumer has on hand, (2) the amount of coal he has on order and the name of the person from whom ordered, (3) the amount of coal used by him in the 12 months ending March 31, 1918, and (4) the amount of coal needed to meet his actual and necessary requirements prior to March 31, 1919; provided, however, that this regulation may be modified by any State Fuel Administrator within his own State under such circumstances and conditions as he may deem proper.

(*d*) On and after April 1, 1918, and until further notice, no retail dealer shall, unless authorized by the State Fuel Administrator, deliver or cause to be delivered to any domestic consumer more than two-thirds of his normal annual requirements of anthracite coal until each domestic consumer who has placed his order with said dealer and is willing to receive delivery of the same has received two-thirds of his normal annual requirements for the year ending March 31, 1919; provided, however, that orders of 6 tons or less may be filled in full.

(*e*) Carload or bargeload lots shall not be delivered to a single domestic consumer or to a group of consumers, except with the permission of the local fuel administrator.

(*f*) Dealers shall file with the local fuel administrator, on the first of each month, a statement containing the names and addresses of consumers to whom deliveries have been made during the previous month and the quantity delivered to each.

Any dealer or consumer who violates the foregoing regulation will be subject to the penalties prescribed by the Lever act.

Such further regulations will be issued as may be necessary to enforce the essential features of the foregoing plan.

The purpose of the plan is to secure the broadest and most equitable distribution possible during the coming year. The Fuel Administration is assured by the representatives of the National Retail Coal Merchants' Association that the retail dealers throughout the country will lend their hearty co-operation in the performance of this patriotic service.

Accompanying the order is a form, reproduced herewith, which consumers are required to fill out before receiving their coal allotments:

Application of Consumer for Annual Requirements.

In accordance with regulations of the United States Fuel Administrator, purchasers, are required to make true declaration in answer to the following questions:

Name of dealer............................
City .... Date..........
Quantity required for year ending March 31, 1919 ....
Quantity required for immediate delivery.....
Quantity consumed during year ending March 31, 1918 ....
Quantity now on hand......................
Kind of building ....
Number of rooms..........................
Kind of heating plant......................
Have you any unfilled orders with other dealers? If so, amount and with whom......

I hereby certify that the above statements are true to the best of my knowledge and belief.

Name ....
Address ....

Any person who wilfully makes a false statement upon the foregoing application is subject to prosecution under the Lever Act, which imposes a penalty of $5,000 fine or two years' imprisonment, or both.

Publications of the United States Fuel Administration.

For the convenience of our readers a list is given herewith of all of the documents issued by the United States Fuel Administration to date. The law creating the administration is listed as "Public No. 41—65th Congress—(H. R. 4961)," being "an act to provide further for the national security and defense by encouraging the production, conserving the supply, and controlling the distribution of food products and fuel":

Publication.	*Date Issued.*	*Subject.*
No. 1.	Aug. 23, 1917.	H. A. Garfield Appointed Fuel Administrator.
No. 2.	Aug. 21, 1917.	Prices of Bituminous Coal Fixed by President Wilson.
No. 2-A.	Oct. 29, 1917.	Amendment to Order of August 21, 1917, relative to Prices of Bituminous Coal.
No. 3.	Aug. 23, 1917.	Anthracite Coal Prices and Jobbers' Margins Fixed by President Wilson.
No. 4.	Jan. 1, 1918.	Summary of Coal Prices in Effect January 1, 1918.
No. 4-B.	Feb. 1, 1918.	Further Classification of Bituminous Coal (Tennessee, Alabama, Virginia and North Dakota).
No. 4-C.	March 1, 1918.	Further Classification of Bituminous Coal (Maryland, West Virginia, Virginia, Alabama, Illnois and Pennsylvania).
No. 4-D.	April 22, 1918.	Coal Prices at the Mine in Effect April 22, 1918.
No. 5.	Sept. 6, 1917.	Task of the Fuel Administration (Statement of H. A. Garfield).
No. 6.	Sept. 7, 1917.	Apportionment of Coal Supply and Regulation of Retail Coal Prices.
No. 7.	Oct. 1, 1917.	Maximum Gross Margins of Retail Coal Dealers.
No. 8.	Oct. 1, 1917.	Shipment, Distribution and Apportionment of Coal Reshipped by Water at Lake Erie Ports.
No. 9.	Oct. 4, 1917.	Rulings of the Fuel Administrator (First Series).
No. 10.	Oct. 9, 1917.	Fuel Supplies for Railroads.
No. 11.	Oct. 26, 1917.	Order Relative to Prices for Coal Received by Water at Docks on Lake Michigan and Lake Superior.
No. 12.	Nov. 9, 1917.	Order Regulating Use of Coal Generating Electricity Used in Operating Illuminated Signs.
No. 12-A.	Dec. 14, 1917.	Amendment to Order of November 9, 1917, Relating to the Use of Fuel in Operating Illuminated Signs, Etc.
No. 13.	Nov. 9, 17, 24, 1917.	Orders Relative to Prices of Coke.
No. 14.	Jan. 14, 1918.	Regulation Relative to the Sale, Shipment, Distribution and Apportionment of Coal and Coke and the Price Thereof in Case of Diversion.
No. 15 (revised).	Dec. 13, 1917. Feb. 25, 1918.	Order Relative to Prices for Coal for Foreign Bunkering Purposes and Export Cargoes; also Amendments of February 25, 1918.
No. 16.	Dec. 24, 1917.	Order Regulating the Making of Contracts by Operators, Producers, and Jobbers of Coal and Coke.
No. 17.	Jan. 17, 1918.	Regulation Providing for a More Adequate Supply of Fuel for Railroads, Domestic Consumers, Public Utility, and Other Uses Necessary to the National Security.
No. 17-A.	March 4, 1918.	Order Modifying Certain Provisions of the Regulation of January 17, 1918, Providing for a More Adequate Supply of Fuel.
No. 18.	Feb. 4, 1918.	Regulation Governing Licensees Engaged in the Business of Distributing Fuel Oil.
No. 18-A.	March 19, 1918.	Revised Rules and Regulations Issued by the United States Fuel Administrator Governing Licensees Engaged in the Business of Distributing Fuel Oil.
No. 19.	March 9, 1918.	Regulations of the United States Fuel Administrator Regarding the Retail Distribution of Coal and Coke for the Year 1918.
No. 20.	March 20, 1918.	Regulations Concerning Cleaning and Special Preparation of Bituminous Coal.
No. 21.	March 22, 1918.	Zone System for the Distribution of Bituminous Coal.
No. 22.	March 22, 1918.	Proclamation by the President of the United States and Rules and Regulations Relative to Licenses for the Distribution of Coal and Coke.
No. 23.	April 1, 1918.	America's Coal Problem in 1918.
No. 24.	April 10, 1918.	Maximum Prices of Coke, with Modification Showing Dates when Effective (Corrected to April 1, 1918).
No. 25.	June 1, 1918.	Regulations Concerning Inspection of Coal at Mines, Methods of Preparation, and Definition of Grades.
No. 26.	May 25, 1918.	Order Reducing Prices of Bituminous Coal in all Producing Districts Ten Cents per Ton.
No. 27.	June 5, 1918.	Order Establishing Regulations and Prices for the Handling and Sale of Bituminous Coal Received by Rail and Water at Docks Located on the Great Lakes.

All the above-listed publications are on file at the office of THE HEATING AND VENTILATING MAGAZINE. Copies may be obtained by addressing the Superintendent of Documents, Government Printing Office, Washington, D. C.

An additional publication issued by the Fuel Administration, under date of August 1, 1918, without number, is entitled "Fuel Facts," and is a compilation of information on the coal situation, with suggestions for operating various types of heaters. Some of these are given herewith:

GENERAL RULES IN MANAGEMENT.

1. Be sure there is a check draft-damper in the smoke pipe, besides the turn damper. This check draft damper is as important in controlling the rate at which the fire burns

as is the throttle of an engine. Open it to check the fire. Close it to make the fire burn more rapidly. Experiment with it in the daily regulation of your fire. Make it do its work. The coaling door was not put on the heater to check the draft. If you cannot check the fire without opening the coaling door, you need proper dampers.

2. The turn-damper should fit the smoke-pipe loosely and must never be entirely closed. With the average plant it may be kept partly closed most of the time in mild weather, but during severe weather it usually needs to be opened wide.

3. Make use of the lift or slide-damper in the coaling-door *only to let oxygen in to consume gases,* if you are using soft or bituminous coal after fresh fuel has been added.

4. Just enough draft and that from below, checking the draft by *letting more air into the smoke-pipe,* is one of the best general rules. This furnishes oxygen from below, necessary for the consumption of the coal-gases, and at the same time gives time for them to be consumed before being drawn up the chimney. This method also avoids escape of coal-gas into the cellar. To make the fire burn more rapidly, do not open the whole ash-pit door, but only the draft-damper in the ash-pit door. Opening the whole ash-pit supplies air to the fire faster than it is needed for combustion. The air is heated, passes out the chimney and is so much heat wasted.

5. All heat pipes in the cellar should be thoroughly and completely wrapped with asbestos or similar covering to prevent loss of radiation.

6. Grates should be cared for properly. A short, quick stroke of the shaker handle will sift the ashes through the grates. Leave grates in flat position when through shaking. Clean ash-pit daily, to prevent damage to grates. In severe weather grates should be shaken until a glow appears in ash-pit. In moderate weather a bed of ashes should be carried on top of the grates.

7. Avoid poking and slicing fire-bed. It causes draft holes and clinkers.

8. Never shake a fire that is low until you have put on a little fresh coal and given it time to ignite. A thin fire wastes coal. Disturb the fire as little as possible.

9. Storm-doors and storm-windows, weather-strips and such protective devices are economical of heat.

10. Keep the temperature of sitting-rooms at sixty-eight degrees or less. If there are invalids, old folk or very little children in the family, the temperature may be higher. Rooms where you do not sit are more comfortable if much cooler, as a rule, providing the air is kept a little moist. Get a thermometer—a good one. Use it inside, not hanging outdoors.

11. It is wasteful to allow the temperature to drop way down at night. It takes twice as much coal to heat it up again next morning.

12. Turn off the heat in unused rooms whenever possible. Bed-rooms should be kept much cooler than living rooms. Don't try to heat all the rooms all the time. If you have a hot-water system, make heavy radiator slip-covers and put them over radiators when not in use. This will prevent freezing.

13. Always keep two pans or open-top jars of fresh water on radiators or in front of registers to keep the air in the home moist.

14. Study the Specific Rules applying to the system of heating in your house.

STEAM HEATERS—SPECIFIC RULES.

1. The water in the boiler should be completely changed at least as often as every spring and every autumn. Draw a bucketful of dirty water from the bottom at least twice a week and each time replenish with fresh water from the supply-pipe. Cleanliness of water in the boiler is of prime importance.

2. Look at the glass water-gauge whenever you attend to the fire. Turn the exhaust-cocks above and below the gauge occasionally to make sure that it is not clogged or the openings to it from the boiler closed up. They must be kept open.

3. The level of the top of the water must always show at some point along the gauge. Its height will vary with the temperature of the water; but if it rises above the top of the glass there is too much water in the boiler and some must be drawn off; and if it sinks below the bottom of the glass some more water must be let into the boiler.

4. Be sure that the exhaust-valve of each radiator works. Sometimes these valves need cleaning with a pin or soaking in kerosene. If in doubt about one of them unscrew it from the radiator when the fire is low and there is no steam-pressure, or else after turning off the radiator. If you can blow through it, it is all right. If not it must be cleaned until you can. Don't fail to replace it. It is advisable to have an extra valve to replace any one that is temporarily out of order.

5. Don't fail to study the General Rules, applicable to all heating-plants, and also to keep the boiler-flues clean.

HOT-WATER PLANTS—SPECIFIC RULES.

1. All the water should be emptied from

the plant and clean water put in at least as often as every spring and every autumn.

2. When the first fire of the season is built, as the water gets heated, take the radiator key and open up the exhaust-valve of each radiator in turn until all the air remaining in each radiator is allowed to escape. Repeat this operation occasionally to make sure there is no air interfering with free circulation of the water.

3. Always be sure that water shows in the glass gauge of the exhaust tank, which is usually located in the top story of the house above the level of all radiators.

4. Be sure the boiler is covered with asbestos, as well as the pipes in the cellar.

5. Study carefully the General Rules relating to all types of plants. Keep heating surfaces of the boiler well cleaned.

◆

Supply of Coal Limited to Cement Manufacturers.

One of the first industries to fall under the ban of the United States Fuel Administrator as non-essential and, therefore, one in which the use of coal should be restricted, is the cement industry, including manufacturers of Portland cement, natural cement and Puzzuelan (slag) cement. Such manufacturers, in a special order dated August 8, 1918, are restricted to an amount of fuel, including coal, coke, natural gas, fuel oil, or other petroleum products, or to use power derived from any such fuel, sufficient to permit them to manufacture 75% of their annual production of cement from January 1, 1915 to December 31, 1917. Provision is made for the burning of additional fuel on certain conditions, after receiving the permission of the United States Fuel Administration. Wood and peat, when not requiring railroad transportation, may be used for the manufacture of cement.

◆

The Country's Coal Requirements.

According to the estimates of the United States Fuel Administration 735,000,000 net tons of coal will be required to meet the demands of the country for the current coal year, ending March 31 next. With the progress of the war and the growing demand for coal this figure may be revised upward.

One hundred million tons of the requirements must come from the anthracite fields, leaving 635,000,000 net tons of requirements from the bituminous mines. The total bituminous production last year was 554,000,000 net tons, which makes necessary an increased production of 81,000,000 tons. The Fuel Administration does not anticipate that the bituminous coal production will go far beyond 600,000,000 net tons. The difference must be made up of savings.

The coal budget made up by the Fuel Administration shows that the requirements for industrial uses will be 242,024,000 tons, which is an increase of 18% over the estimated consumption for last year.

For domestic uses 75,678,000 tons of soft coal has been allotted.

The gas and electric utilities have been apportioned 37,941,000 tons this year, as against 33,038,000 tons consumed last year, an increase of 15%.

The railroads require this year 166,000,000 tons as against 155,000,000 tons last year, the increase amounting to 7%.

The mines themselves will use 12,500,000 net tons this year, whereas 11,000,000 tons sufficed last year. The increase amounts to 14%.

Two million additional tons will be required to take the place of oil, principally in the West.

◆

Plans of the United States Fuel Administration for Inspecting Steam Power Plants.

As has already been announced in these columns, the United States Fuel Administration is about to conduct an investigation of all the steam-power plants in the country with a view, first, of securing their more efficient operation in order to reduce the total coal consumption, and, second, of curtailing the allottment of coal to those plants which fail to comply with the recommendations of the fuel administration.

At the time of writing (August 22) the work of inspection is in its initial stages, being confined largely to the preparation and sending out of the fuel administration's questionnaire and recommendations. Both of these circulars are reproduced herewith. We are indebted to *Power* for the arrangement of the circulars for reproduction. A few inspectors have been sent out but from this time on the work is expected to proceed rapidly.

Special attention is called to the fact that a power plant will automatically fall into the lowest class of rating until the questionnaire is duly executed and returned. Following the first report authorized inspectors will call at the plants and efforts at fuel conservation will be noted and will be a means for securing a higher rating for such plants.

◆

American Public Health Association will hold its annual meeting in Chicago, October 14-17, 1918.

Standard Questionnaire Covering

Issued by Bureau of Conservation

THIS FORM FOR GENERAL INFORMATION—NOT TO BE USED FOR RATING OF PLANT.

Date of Report.............
Name of company, concern or owner...............
Address of Central Office..........................
Name and location of plant inspected................
Character of product or service.....................

STATIONARY BOILERS

WATER-TUBE BOILERS

Number	Hp	Kind of Draft			How Fired		Total Hp	Remarks
		Nat'l	Forced	Induced	Stoker	Hand		

FIRE-TUBE BOILERS

Number	Hp	Kind of Draft			How Fired		Total Hp	Remarks
		Nat'l	Forced	Induced	Stoker	Hand		

MOVABLE BOILERS*

Number	Hp	Type	Remarks

* In the rating of the plant movable boilers will be considered separately. The questionnaire does not call for information regarding movable boilers except as per above table. The influence of movable boilers on the rating of the plant will be left to the judgment of the Administrative Engineer.

Kind of coal.... .... Bituminous Semibituminous Anthracite
Size ....

Tons of coal of 2000 lb. used during twelve months ending May 1, 1918.......................

Months of operation of plant during the same year.......... .....

Approximately what percentage of live steam is used for:

	Winter Per Cent.	Summer Per Cent.
(a) Making power	...	.....
(b) Heating building.	......	......
(c) Process work..	......	......

Is purchased electric power used? ....

If so, how many kilowatt-hours consumed during twelve months ending May 1, 1918? ....

RECORDS

Are records kept to show any of the following information? Answer "Yes" or "No" in table.

	By Shift	Daily	Weekly	Monthly
Water evaporated by boilers....	....	....	....	... .
Coal consumed by boilers.......	....	....	....	......
Flue-gas analysis..... .. .	....	....	....	....
Electrical output or consumption kw.-hr..........................	....	....	....	....

ENGINE EQUIPMENT

STEAM UNITS—ENGINES, TURBINES, PUMPS

Type	No	Initial Pressure	Rating		Condensing	Noncondensing	Type of Valve Gear
			Hp.	Kw. or Gal. Per Min			
Simple.							
Compound							
Turbine							
Steam Pumps.							

What changes have you in progress which are expected to reduce your fuel consumption?

....

When will they be in effect?

....

Further remarks by owner:

....

Note to Owner: If sufficient space is not available in the questionnaire, please attach an extra sheet with the additional information.

RECOMMENDATIONS BY THE FUEL ADMINISTRATION

That provision be made for weighing and recording of the fuel used each shift or day.

That feed water be heated and measured.

That provision be made for an adequate supply of air to the fuel and convenient means provided for the measurement and control of the draft.

That provision be made to keep boiler surfaces clean inside and out.

That the grates be in good repair, that settings, breeching and access doors be free from air leakage, and that boiler surfaces wasting heat be covered with insulation.

That the surfaces of steam piping, drums and feedwater heaters which waste heat or steam by radiation be properly covered with insulating material.

That exhaust steam be utilized wherever possible, to the exclusion of direct steam from the boilers. The plant should be so designed that no more exhaust steam will be produced than can be efficiently utilized in heating or process work.

That a competent man in the plant be detailed for the work of fuel conservation in the boiler and engine rooms.

That a competent man or committee be detailed for the work of fuel conservation in the building or shop outside of the power plant.

the Operation of Steam Power Plants

United States Fuel Administration.

THIS GROUP OF QUESTIONS TO FORM BASIS OF RATING OF PLANT.

(a) **Fuel:** Value of question, 9. Mark rec'd......

Question 1. What provision is made for weighing fuel used each shift or day?

Question 2. What records are made of fuel used each shift or day?

Question 3. What grate surface is in use each shift, exclusive of banked fires?

Question 4. Total coal used each shift exclusive of banked fires?

(b) **Water:** Value of question, 15. Mark rec'd . ..

Question 1. What provision is made for heating and continuous measuring of feed water (check answer in table below)?

Heating	Means Used for Measuring
Open feed-water heater	....
Closed feed-water heater	....
Exhaust steam	....
Direct steam	....
Waste heat economizer	....

(c) **Air Supply:** Value of question, 12. Mark received ....

Question 1. Are means provided for measuring the draft over the fire?

Question 2. Are means provided for determining the excess air by flue-gas analysis?

Question 3. Are dampers provided for equalizing the draft in the furnaces?

Question 4. Is there a convenient means for regulating the draft by main or uptake damper?

Question 5. Is there an automatic damper regulator in working order?

(d) **Clean Heating Surfaces:** Value of question, 12. Mark received ....

Question 1. What provision is made for keeping soot and ashes from boiler-heating surfaces (mark answer in table below)?

Steam lance for blowing soot by hand........ ....
Mechanical soot blower........ ....
Brushes or scrapers.. ....

Question 2. How often are the soot and ash cleaned from the boiler-heating surface?

Question 3. What provision is made for keeping scale and sediment out of the boiler (check answer in table below)?

Chemical treatment of feed water in the boiler...... ....
Chemical treatment of feed water outside of boiler.... ....
Filtration of feed water in open feed-water heater... ....
Filtration by means of feed-water pressure filter..... ....
Other means.......... ....
Water is free from scale or sediment without treatment ....

Question 4. What means are used for removing scale from the boiler?

Hand. .... Mechanical............ ....

(e) **Boiler and Furnace Setting:** Value of question, 20. Mark received..............

Question 1. Are the grates warped, broken or otherwise defective?

Question 2. Check air leaks observed, as follows:

Leaks in boiler setting.......... ....
Openings between boiler and setting.......... ....
Badly warped fire-doors.......... ....
Badly warped cleaning or access doors.......... ....
Leaks around blowoff piping.......... ....

(f) **Insulation:** Value of question, 7. Mark received ....

Check any of the following items where saving could be made by covering surfaces with insulation:

Exposed drums of boilers.......... ....
Exposed shells of boilers.......... ....
Steam piping in boiler room.......... ....
Steam piping in engine room.......... ....
Feed-water heater.......... ....
Exhaust-steam piping where fuel could be conserved by covering.. ....
Feed lines.......... ....

(g) **Engine-Room and Heating Systems:** Value of question, 15. Mark received..........

Question 1. Is exhaust steam used: Entirely...... partly......not used?......

Question 2. State service for which this steam is employed: Heating......Cooking..... Dry room......Tank heating......Low-pressure turbines...... Other purposes ....

Question 3. Is there an excess of exhaust over requirements?

	Day	Night
Winter	....	....
Summer..........	....	....

Question 4. Is there any low-pressure live steam used in the plant?......At what pressure? ....lb. gage. For what purpose?...... Heating...... Cooking......Dry room ...... Tank heating...... Other purposes.......

(h) **Supervision:** Value of question, 10. Mark received ....

Question 1. Has the owner detailed a competent employee to supervise the work of fuel conservation in the boiler and engine plants with directions to report weekly on measures for economy and progress in conservation of fuel?

Name and title of this employee

....
....
....

Question 2. Has the owner appointed a man in charge of the work of fuel conservation outside of the boiler and engine rooms described under Recommendations?

Name and title of this employee

....
....
....

How Leaking Steam Ran into Money in a Hotel Plant

Remarkable Savings Effected at the Cleveland Hotel Statler Through Changes in the Heating System.

Saving $11,000 on the steam bill of a modern hotel during one season's operation will be admitted to be a remarkable achievement, yet this is what has been accomplished at the Cleveland Hotel Statler, following certain changes in the equipment of the plant.

It should be stated that for some time the consumption of low-pressure steam for heating the Hotel Statler in Cleveland was considered by the management to be excessive. An investigation was undertaken about a year and a half ago by J. G. Morgan, supervising engineer for the Hotels Statler Company, and a report was submitted to Mr. Statler with recommendations that certain alterations be made in the heating system to effect an estimated saving of approximately $6,000.

The recommendations were approved by Mr. Statler and the alterations completed as planned at a cost of $8500. They consisted principally of installing new valves on the return ends of the radiators in place of those in use.

We are indebted to Mr. Morgan for the following, taken from his official report:

The accompanying consumption record (Table 1) gives an idea of the savings effected by the alterations, although it should be borne in mind that a concerted effort was put forth toward the conservation of steam. One point, however, is certain. Prior to the installation of the new equipment, it was found impossibe to maintain a vacuum on the heating system without the use of a ¾-in. jet water introduced into the water end of the vacuum pumps to condense the steam that leaked through the old valves. This past season no jet water was used and the vacuum has been maintained without difficulty.

In Table 1 the consumption record is given in pounds condensation, the measurements being taken at the meters after the steam had passed through the radiators and returned to the receiving tanks by the vacuum pumps. Owing to the difference of mean temperatures for the various months, a credit should be allowed for a theoretical increased consumption in 1917-1918, when the mean temperatures were lower than in 1916-1917, and a debit when the temperatures were higher.

Subtracting Column 5 from Column 1, we show an actual saving, states the report, of 7,504,109 lbs. low-pressure steam in the first six months of the heating season 1917-1918, as compared with the same period of the 1916-1917 season. To this add 5,471,000 lbs. rebated to the hotel by the Cleveland Electric Illuminating Company on account of a leak in a steam coil in a hot-water generator, giving a total of 12,975,109 lbs. less steam used during this period, which at 35 cents per 1000 lbs. amounts to $4,541.28.

Add 401,109 cu. ft. city water at 40 cents per 1000 cu. ft. (used as jet water in 1916-1917), amounting to $160.44.

Add also cost of 75 tons of coal at $5.00 per ton (charged to Cleveland Electric Illuminating Company), equalling $375.00. Adding the foregoing three items gives a total actual saving of $5,076.72.

This, however, does not tell the whole story. Column 9 of Table I shows the net average percentage credit due, amounting to 12½%. Figures compiled by users of the Cleveland Electric Illuminating Company's low-pressure steam (taken from invoices of 1916-1917 and 1917-1918 seasons) operating under the same conditions, show an increase of approximately 20%. Figured on this basis the increased consumption credit for 1917-1918 was 10,624,287 lbs., which at 35 cents per 1000 lbs., amounts to $3,718.50.

On account of leakage in the bathroom radiators, approximately 500 of them were replaced. With this and the steam lines to the other radiators cleaned out, there have been added approximately 2800 sq. ft. of direct radiation in those rooms. Based on a consumption of 4 sq. ft. to 1 lb. condensation per hour, ten hours per day, 30 days per month, seven months per heating season, we have an additional estimated steam consumption of 1,764,000 lbs. over 1916-1917. Figuring this amount of steam at 35 cents per 1000 lbs. gives a total of $617.40 to be credited to 1917-1918 operation.

During March, 1918, the rate on low-pressure steam was increased by the Cleveland Electric Illuminating Company from 35 cents per 1000 lbs. to a sliding scale which will average about 68 cents per 1000 lbs. This rate will continue in force unless changed by decision of the court. There is now an injunction suit in progress. This increase, for the month of March, 1918, would add a credit of 4,671,922 lbs. which at

1 Month	2 Pounds	3 Mean Temp. Deg. F.	4 Month	5 Pounds	6 Mean temp. Deg. F.	7 Diff. in mean temp.	8 Percentage of credit or debit based on 1916-1917 consumption	9 Pounds Credited or debited compared with 1916-1917 consumption	10 1917-1918 Computed consumption if operated on 1916-1917 basis, pounds
1916			1917						
October	9,154,343	52.7	October	9,469,112	46.5	—6.2	+.40	3,661,737	12,816,080
November	9,786,349	42.3	November	11,225,297	38.2	—4.1	+.23	2,250,860	12,037,209
December	11,774,264	29.0	December	13,611,430	22.4	—6.6	+.21	2,472,795	14,247,059
1917			1918						
January	16,133,752	27.3	January	15,583,769	15.0	—12.3	+.29	4,678,780	20,812,532
February	14,356,038	21.3	February	9,951,153	28.2	+ 6.9	—.15	2,153,405	12,202,633
March	14,683,020	37.3	March	8,542,896	40.2	+ 2.9	—.10	1,468,302	13,214,718
	75,887,766			68,383,657					85,330,231

35 cents per 1000 lbs., amounts to $1,541.73.

The house count for the six-month period has been slightly under 3% less than for the same period of last season. For this we should deduct 3% of 75,887,766 lbs., or $843.07.

Finally, there is the estimated saving on steam consumption for the balance of the year. If the increased rate continues in force, this will amount to 2,170,743 @ 33 cents = $716.34.

RECAPITULATION.

Actual saving 1917-1918 over 1916-1917	$5,076.72
Percentage credit on account of lower mean temperatures	3,718.50
Added radiation	617.40
Increase on account of higher rate	1,541.73
	$10,954.35
Deduct on account of lower house count	843.07
Total saving for first six months of heating season	$10,111.26
Estimated saving on steam consumption balance of fiscal year, 2,170,743 lbs. @ 35 cents per 1000 lbs.	759.75
Additional saving if increased rate continues in force	716.34
Total estimated saving for the year	$11,587.39

Since rendering the foregoing report the engineering department has kept a record of the steam consumption for the additional months to August 1, 1918. The comparative figures are as follows:

	1917		1918	
	Pounds	Mean temp. Deg. F.	Pounds	Mean temp. Deg. F.
April	9,199,216	45	8,867,431	46
May	8,182,886	51	3,763,439	64
June	3,987,525	65	2,122,000	67
July	2,280,000	..	1,265,000	..

The steam for guest-room heating was turned off during the last month of May. The consumption for June and July was for hot water heating. The saving of approximately 1,000,000 lbs. was accomplished by alterations that stopped leaks, as well as by reducing the consumption of hot water in the hotel laundry.

◆

National Safety Council will hold its seventh annual congress in St. Louis, Mo., September 16-20, 1918. Headquarters will be at the Hotel Statler. Special sessions will be given over to health work in the industries.

Leaky Windows an Unnecessary Handicap to the Heating Industry

By Alfred M. Lane.

Today building construction might be considered almost a science. Practically every single item that enters into the construction of buildings, of any class, has its valuation determined to a high degree of accuracy. We know the bending moments of steel, the breaking strains of cast-iron, the tensil strength of cement, the weathering value of paint, the rust-resisting qualities of galvanized iron, and various other materials too numerous to mention. The architect must necessarily know absolutely the character of the materials he proposes to use in the construction of the building in his charge, and he designs it with the perfect confidence, as a result of experience, tests, etc., that with these materials a building will stand as a monument to his knowledge of what is safe and practical.

The heating engineer completes the building, insomuch as he makes it habitable. He, in turn, determines with the same degree of accuracy the size of radiators, risers, returns, mains, boiler and valves, with the necessary fuel consumption to properly heat the building. His calculations, however, cannot be 100% accurate, because he must guess at the amount of radiation to offset the in-leakage of cold air on the windward side, and the out-leakage on the leeward side around the windows and doors of the building.

This leakage can never be determined absolutely because the human equation enters into the construction and fitting of sash and doors. A mechanic will not fit two windows in the same room with exactly the same amount of cracks between the sash and the frame. The character and age of the wood is a large factor. One side of the frame will shrink more than another. Time and expense does not permit guarding against every detail that would affect the fitting and hanging the sash.

For instance, it is good practice, in the brick specifications, to call for brick to be shoved and grouted, which necessarily follows that this slushed mortar must fill in around each frame. The wood in the frame absorbs a large percentage of the mortar. The initial set of the cement is approximately two hours; therefore, the frame has only one way to swell, and that is inward, or away from the brick at the center. This is the reason you will find the center of the frame narrower than at the sill or head, also the sill buckled up, making the height in the center shorter than at the sides. It is necessary to fit a sash so that it can be raised and lowered past the narrowest part of the frame, to wit: where the meeting rails come toegther when the window is closed. As a result, there is a crack on each side of the sash at the head and sill that is much larger than the crack at the meeting rail.

SIZE OF AVERAGE WINDOW CRACK

It is a well-known fact, proven by twenty years' experience in the building business, that the average crack around a window is approximately one-eighth of an inch. A 3 ft. x 7 ft. window, which is common, will have 20 ft, of cracks around the sides, top and bottom, and 3 ft. at the meeting rail, making all together 23 ft. of cracks one-eighth of an inch wide, equivalent to 34½ sq. in. of an opening that permits cold air to enter on one side and warm air escape on the other side of the building. This handicap on the heating apparatus must be overcome by excess radiation and an oversize boiler.

If there was a hole left in the glass of each window six inches square, the owner and architect would refuse to accept the building from the contractor. It would be obvious to every one that these holes would have to be closed up to make the building fit for occupancy. The principal reason for the rejection of these windows with the holes in them would be on account of their being seen, but, on the other hand, if the same area was divided into small holes scattered over the wall area of a room, nothing would be said if they were not noticeable, and accepted on the theory that "what you don't know won't hurt you." This is the same theory on which thousands of architects, heating engineers and owners accept a building with the same size hole, except it is in the form of a crack around the windows.

The writer has always considered a heating specification very similar to a purchase contract of lightning rods; there is a joker in it. Heating specifications invariably state a building shall be heated to a temperature of 70° F. inside when the thermometer is zero outside, but nothing is ever said at what wind velocity, and yet heating engineers agree that it is much harder to heat a building to 70° inside when the thermometer is 30° outside, with a wind velocity of twenty miles an hour, which is common in the winter, than it is to heat a building to the same temperature with the thermometer zero outside, and *no* wind. Therefore, as stated above, the heating engineer must necessarily take into his calculations a "guess."

The only absolute way to control the leakage around the windows is by properly weather stripping them, and they should be a part of the heating engineer's specifications just as much as the character of the valve, wall thickness of pipes, kind of covering and size of flue to the boiler. He provides for expansion in his pipe lines, and water in a hot-water system, and should make the same provision for expansion and contraction between the sash and the frame. Specifications should read: "These plans and specifications for heating apparatus are designed to heat a building at a temperature of 70° inside with the thermometer zero outside, in any wind velocity, providing all windows and doors are weather-stripped with an equipment that shows not more than one-half cubic foot air leakage for every lineal foot of cracks around a window; weather strips shall be adjustable to swelling, shrinking and warping of the sash, under all conditions, guaranteed by the manufacturer against defective workmanship and material for a period of five years."

It is the writer's opinion that nine-tenths of the heating Engineer's trouble is due to leaky windows. He is held responsible for an over-consumption of coal, too much or too little heat, and is helpless to overcome it because he is not responsible for the general construction of the building. A well-known heating engineer once said: "It is an easy matter to heat a well-constructed building, but it is possible to design a plant that will heat a bird-cage." A building resembles a bird-cage insofar as the cracks around the windows are concerned. It is by far more important to control the air leakage around the windows with metal weather strips than it is to control the supply of steam or water to the radiators with valves. Weather strips will contribute more to the economic operation of a heating plant, the health and comfort of the occupants, than any other single device entering into the construction of a building. Besides weather strips are the only items in the building that are not a source of expense of upkeep and repairs. If it is necessary to prevent leaks in any part of the heating systems that conveys heat to a desired location, why is it not just as necessary to prevent leaks around windows and doors that convey cold air to those same locations? Boilers and pipes are covered to prevent heat losses by convection. Why not fill cracks around windows and doors to prevent heat losses by conduction?

The heating engineers, through their society should, in the writer's judgment, take immediate steps to conduct a scientific test of the efficiency of metal weather strips, classifying them according to the results, the same as other materials have been classified, and then lay out their plans and prepare their specifications according to the type of weather strip to be used, placing the ultimate responsibility where it belongs on the owner.

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The Hitch in Heating Houses by Electricity.

In the application of electricity to heating buildings, this has a seasonal requirement, having the period of maximum demand usually short and having a long period in the summer when there is no demand. It can be supplied economically by electricity only where the generating stations are without other load in the winter time. This occurs very rarely, but there are a few cases, such as occur in irrigated regions in which water is pumped by electricity which in turn is generated from water-power. Here, it is necessary to keep a load on the plant to prevent freezing in the winter and this can best be accomplished by connecting a heating load to the lines. If a fuel-fired generating station were to be large enough to care for this maximum peak-load which would occur in the coldest winter weather and which would be superimposed on the usual power and lighting load, the investment for the plant and the distribution system would be very high and it is doubtful whether it would be possible to furnish the energy for heating as cheaply as the coal could be bought and burned. Continuity of domestic heating in cold weather is also a vital point. Failure of the power system would bring wholesale disaster to the community relying on it for heat. Not that there are no cases in which such heating can be done satisfactorily, for there are many special cases in which such electric heating of spaces in buildings may be commercially economical. In general, however, at the present time, with Nature's stores of fuel to draw upon, the general substitution of electricity for fuel for this purpose does not seem probable.—*Frank Thornton, Jr., before the Engineers' Society of Western Pennsylvania.*

Modern Practice In Vapor Heating

Editor's Note.—*For the purpose of this series of articles, a vapor, vacuum, vapor-vacuum, vacuum-vapor, atmospheric, modulated or themograde system of heating will be considered as any system in which the steam pressure ordinarily carried is practically at atmosphere or slightly below or in which the returns are open to the atmosphere and where no pump or other positive mechanical device is employed to pull back the returns.*

III.—The McAlear System.

The McAlear Mfg. Co., of Chicago, Ill., makes vacuum and vapor appliances for a variety of uses and has developed its own systems of vapor and atmospheric character. These are separated into two separate and distinct systems which are differentiated by this manufacturer as follows:

"A *vapor* system is one which generally operates within 2 lbs. of atmosphere and should be provided with some positive means to return condensation to the boiler at any pressure difference between the boiler and the returns."

"An *atmospheric* system is one which is operated at within a few ounces of atmosphere and depends for its successful performance on very sensitive damper regulation since any rise in boiler pressure will prevent the return of the condensation."

The distinction as above enumerated practically boils down to a vapor system being capable of carrying up to 2 lbs. gauge pressure (due to the automatic return trap being able to return the water to the boiler under this pressure) whereas the atmospheric system has no such return trap and therefore must operate at a lower pressure of only a few ounces.

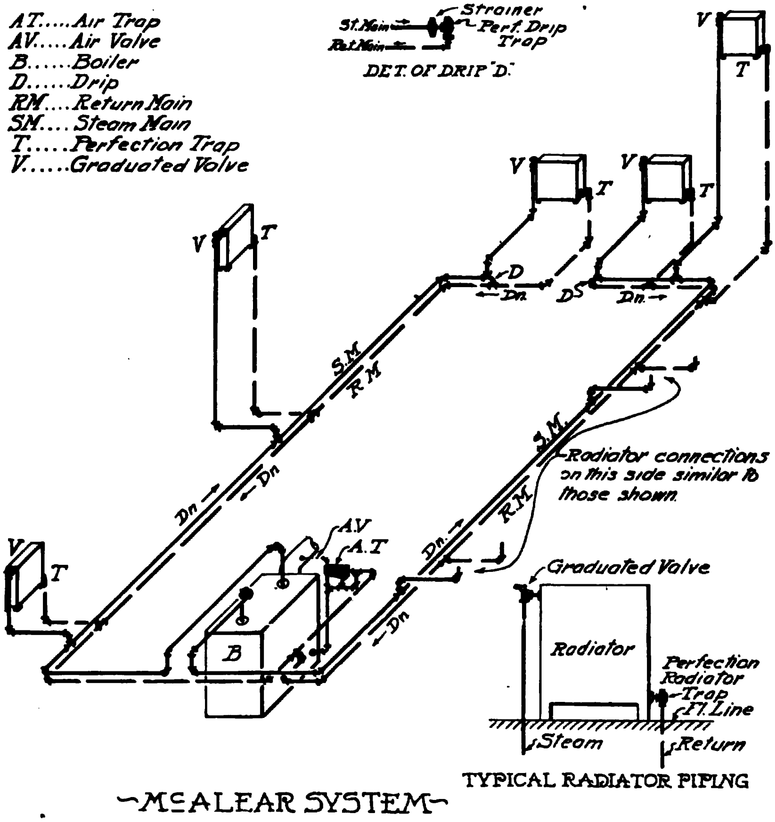

FIG. 1—TYPICAL LAYOUT OF McALEAR SYSTEM.

The chief advantages mentioned for the vapor system include:

First.—A rapid and quick circulation of steam throughout all radiators with steam pressure not to exceed 3 oz. or 4 oz.

Second.—The automatic removal of air and water from the radiators and piping system to the air exhauster and return trap located on the boilers, discharging the air to the atmosphere and the water of condensation into the boilers.

Third.—The economy in operation due to the Circulation of steam at low temperatures, making it possible to operate with the same degree of economy as a hot-water heating system, but with a much higher efficiency due to the rapid heating and cooling of the radiators, which is very advantageous in the Fall and Spring when only a little heat is required to take off the chill.

Fourth.—The pressures necessary for the circulation of steam on the system varies anywhere from a few ounces above the atmosphere up to any pressure necessary to get a circulation and heat. It is not necessary that the pressure be maintained at any particular fixed point with this system, but the greatest economy is had by circulating at 1 lb. or less.

Fifth.—The omission of air vents with the exhauster and return trap located on the boiler which exhauts all of the air from the system and discharges it to the atmosphere, and also receives the water of condensation and discharges it into the boiler.

Sixth.—The economy in operating over ordinary heating plants which depends largely on the pressure carried and the construction of the plant. If properly installed the saving in cost of operation will vary anywhere from 10% to 25%.

The requirements consist of special modulation valves on the radiator supplies, special traps on the radiator returns, a special return trap or special air valve at the boiler and (with the atmospheric system) a special super-sensitive damper regulator.

The *vapor* system with which this article particularly deals is illustrated in Fig. 1 and consists of a two-pipe system, the steam being carried from an ordinary steam boiler through a common and regularly-piped steam main up to the radiators into which it is fed through a graduated supply valve called by the manufacturer a "modulating" valve.

The steam and return main must be liberally sized so as to reduce the pressure drop to a minimum, while the return should be only one or two sizes smaller. The mains must be properly pitched and drained through traps to prevent steam blowing through into the return line. The return must run without pockets and be pitched in the direction of flow in order to permit freedom of air removal.

The modulating valves are of the packless type, their interior construction being shown in Fig. 2, and they are made in the sizes and carry the dimensions shown in Table I.

TABLE I.

	Inches.				
Size of Valve	½	¾	1	1¼	1½
Face of Outlet to Center Line of Inlet........	1¼	1 5/16	1½	1¾	2
Face of Inlet to Center Line of Outlet........	2½	2⅞	3¼	3½	3⅞

These valves are made in angle pattern only and employ varying discs to suit the different sizes of radiators, these discs being as shown in Table II.

TABLE II.

½-in. Valve					
Disc. No................	1	2	3	4	5
Radiation, Sq. Ft.......	1–20	20–35	35–50	50–65	65–80
¾-in Valve					
Disc. No................	6	7	8	9	10
Radiation, Sq. Ft.......	1–25	25–50	50–75	75–100	100–125
1-in. Valve					
Disc. No................	11	12	13	14	15
Radiation, Sq. Ft.......	25–50	50–75	75–100	100–150	150–200
1¼-in. Valve					
Disc No.................	16	17	18	19	20
Radiaiton, Sq. Ft.......	75–100	100–125	125–150	150–175	175–200
1½-in. Valve					
Disc. No...............	21	22	23	24	25
Radiation, Sq. Ft......	100–125	125–150	150–175	175–200	200–250

On the return end of each radiator is placed a "Perfection" radiator trap, a cross section of which is shown in Fig. 3. This trap is designed to close whenever a vaccum is created in the radiator and thus to prevent heating through the return connection; at the same time it is claimed that they permit the escape of air and water from the radiators in large quantities but close absolutely tight against steam, and when the radiator is shut down, prevent water and steam backing in through the return connection.

The chief advantages of these traps consist of having full ⅜-in. opening, being non-adjustable, self-cleaning, automatic, noiseless and fool-proof. By swinging on the union the outlet may be pointed down, or 45° forward or back. This obviates the necessity of employing right and left hand valves; it is not impossible to turn the outlet horizontally if necessary but this is not recommended as the valve does not drain itself fully when set in this position.

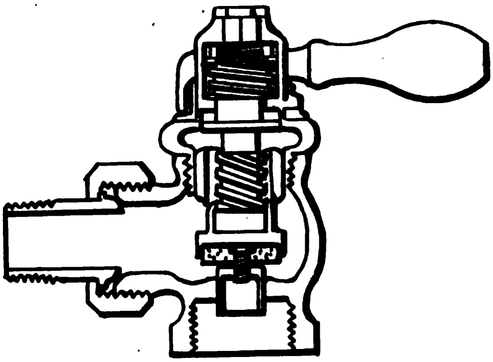
FIG 2—CONSTRUCTION OF McALEAR GRADUATED VALVE.

These traps are known as No. 28, come in one size only, ½-in., and are good for anything up to 300 sq. ft. of direct cast-iron radiation. For blast coils and other large amounts of surface a larger trap is made, this being known as No. 34 and of ¾-in. size.

The dimensions are as shown in Table III.

TABLE III.

Dimension	No. 28 Inches	No. 34 Inches
Face to Center of Inlet..	2 1/16	2⅞
Face to Center of Outlet	2½	1⅞
Diameter of Valve Body	2⅜	3¾

For special cases valves with the diaphragms turned horizontally are provided.

After passing through the radiator trap the air and condensation follow down the return line and back to the boiler. Near the boiler the return line has connected in parallel an "air exhauster and return trap"; a cross-section of this automatic return trap is shown in Fig. 4. It operates whenever the boiler pressure is sufficient to back the return up into its chamber. The principle of operation is the rising return which lifts the float and opens the steam inlet D. This equalizes the pressure on both sizes of the water so that the water falls into the boiler by gravity. After discharging, the air relief opens, relieves the steam pressure, the returns again flow into the trap and the process is repeated.

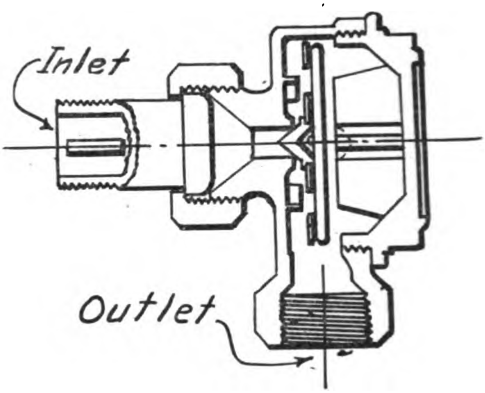

FIG. 3—PERFECTION RADIATOR TRAP USED WITH McALEAR SYSTEM.

The *atmospheric* system follows throughout the same piping, valves and radiator connections described for the *vapor* system *except at the point where the returns enter the boiler*. Here no automatic return trap is provided but instead a Kieley air trap is substituted, this trap being constructed as shown in cross section in Fig 5 and with the piping arranged as shown in Fig. 6. These traps are built in eight sizes for vari-

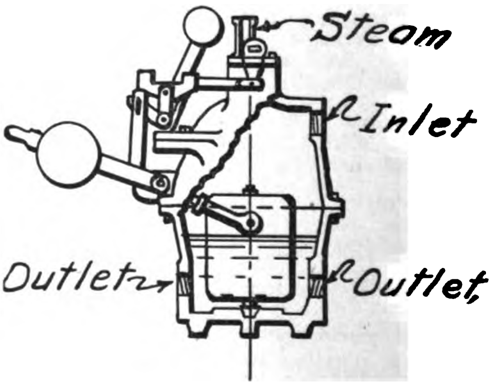

FIG. 4—AIR EXHAUSTER AND RETURN TRAP.

ous heating system capacities, as shown in Table IV.

TABLE IV

No. of Trap.	Sq. Ft. Radiation.
0	0 to 900
1	901 to 1300
2	1301 to 2000
3	2001 to 3300
4	3301 to 5000
5	5001 to 8300
6	8301 to 11500
7	11501 to 16500

As can be seen, this trap simply and solely relieves the air from the system and does nothing to help return the condensation against the boiler pressure. Thus a very small increase in the boiler pressure is sufficient to flood the return and air bind the system if the return main is anywhere near the same level as the boiler water line. For this reason the vapor regulator illustrated in Fig. 7, is used to control the heating boiler, this being a very sensitive device which gives control of the boiler pressure by ounces and will operate at any pressure from 3 lbs. gauge down to 5 in. of vacuum.

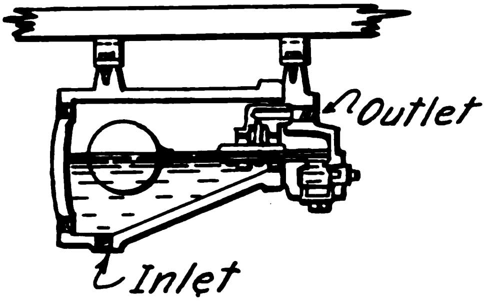

FIG 5—KIELEY AIR TRAP.

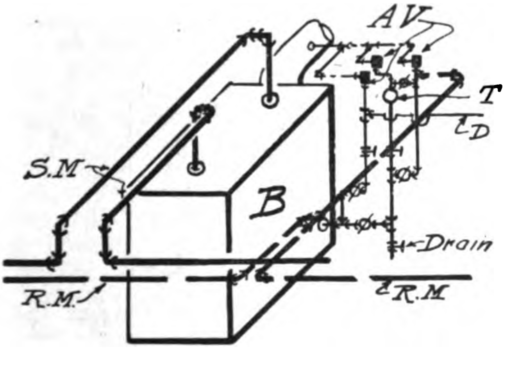

FIG. 6—ARRANGEMENT OF PIPING IN ATMOSPHERIC SYSTEM.

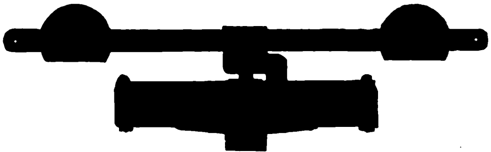

FIG. 7—VAPOR REGULATOR FOR CONTROLLING DAMPERS AND CHECK DRAFTS.

LEGAL DECISIONS

Quantum Meruit for Labor and Materials.

In an action on quantum meruit for a balance due for materials and labor furnished in installing a heating plant in the defendant's building, the Missouri Supreme Court holds, Bradley Heating Co. *v.* Layman Realty, etc. Co., 201 S. W. 864, that where the owner of the building had breached the contract, the plaintiff was entitled to an instruction for the reasonable value of the materials and labor furnished, at least up to the contract price. Where there were no structural defects in the boilers funished by the contractor, and they were the identical boilers specified in the contract, it was not error to exclude evidence by the owner of that type of boiler. The plaintiff was not concluded by what he paid for the labor and materials furnished if he showed their reasonable value exceeded such sum.

Mechanic's Lien for Heating Plant.

The Minnesota Supreme Court holds, L. J. Mueller Furnace Co. *v.* Burkhart, 167 N. W. 286, that a complaint in an action to enforce a lien upon realty for a heating plant furnished for the improvement of a building thereon, including a copy of the lien statement, reciting that the plaintiff had a lien for a certain amount for a heating plant sold and delivered to a third party and used in the defendant's dwelling, signed and verified by the manager of its state branch, not technically showing the reasonable value of the material furnished, or whether the third party had paid the plaintiff therefor, or fully alleging any contractual relation between the plaintiff and such third party, was sufficient to give notice of the plaintiff's claim, and to entitle it to amend the complaint.

Contest for Possession of Tools and Equipment.

A contracting company, which became bankrupt, entered into a contract with a high school commission for the furnishing and installing of heating and ventilating apparatus for a high school building which was being erected or to be erected. The contract provided that if the work to be done under it should be abandoned by the company, or if the contract should be assigned or the work sublet other than as specified, or if at any time the architect should be of the opinion and should certify that performance of the contract was unnecessarily or unreasonably delayed, and that the company was violating any of the conditions or covenants, the commission should have the power to require the company to discontinue all work on three days' written notice, and that the commission might complete the contract in the manner provided by law, charging the company with the expenses, materials, labor, etc., which should be deducted from the contract price. The contracting company, which agreed to save a surety on its bond harmless, for that purpose executed an agreement reciting the assignment, transfer, and conveyance to the surety of all its title and interest in and to tools, equipment, and materials placed upon the site of the work, or which might be purchased for the work.

In a contest for possession of the tools and equipment the federal district court for the Northern District of New York holds, in re F. J. Sullivan Co., Inc., that the mere placing of the tools and equipment on the site of the building did not, on the theory that the contract with the commission was one of pledge, give the commission title to the property superior to the trustee in bankruptcy of the company, even though it is not necessary in every case that the pledgee himself take possession, for, as the company remained in possession until bankruptcy, and had complete control of all the property, it could not under any theory be deemed that the commission had possession.

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How the Chicago Master Steam Fitters Came to Join the National Organization.

The addition of no fewer than 115 Chicago heating contracting firms to the membership of what is now the Heating and Piping Contractors' National Association was one of the most important events of the year in that organization. Some interesting details of the developments that led up to this action are told in the report of the association's board of directors, published in the association's *Official Bulletin* for August.

On October 25, 1917, states the report, President Almirall and Messrs. Grassler, Danforth and Bradley made a special trip to Chicago at the invitation of the Master Steam Fitters of Chicago to interest them in the national organization, and to extend to them individually and collectively an invitation to join the organization. The Chicago Association comprises about 115 men.

"We met with a most cordial reception at a noon luncheon," continues the report. "We were the guests of honor at a banquet in the evening, and if the 1917 convention had been held in Chicago, as planned, there is no doubt but that the Chicago organization would have become affiliated with us.

"But, with the entrance of the United States into war with Germany, conditions generally throughout the country were so upset that the directors at a meeting held in New York City on May 17, 1917, decided to postpone the regular annual convention, which otherwise would have been held in Chicago in June.

"As a result of postponing the 1917 convention no action was taken by the Chicago Master Steam Fitters' Association until April 23, 1918. On that date, at the request of the Chicago Association, Messrs. Oakes and Danforth, representing your board of directors visited Chicago and had the pleasure of attending a dinner at Hotel Sherman, which preceded the regular monthly business meeting. About 100 members were present. After dinner the Chicago association showed its patriotism by subscribing about $70,000.00 to the Third Liberty Loan, practically all of this being made up of additional subscriptions from individual members. This action was a wonderful demonstration of what men can do when they get together and associate with each other for a definite purpose.

"President Herlihy then introduced our Mr. Oakes to the meeting, and Mr. Oakes extended to the Chicago association an invitation to join our national association. He very clearly explained the purpose of our organization in a very interesting address. Your chairman (Mr. N. Loring Danforth of Buffalo) followed Mr. Oakes in an endeavor to set forth those things which our association has accomplished, and the reasons why the Chicago local association should become members of our national body.

"As a result of this visit to Chicago, and of previous efforts on the part of the gentlemen representing us, who attended the Chamber of Commerce Convention a few weeks before, in April, I am very glad to announce that the Chicago Association decided that night to affiliate in a body with our national association. The action taken that night, which was informal, has since been ratified, and the Chicago Association of Master Steam and Hot Water Fitters, comprising about 115 members and constituting one of the strongest local associations in the country, are today fully qualified members of our national association."

NATIONAL DISTRICT HEATING ASSOCIATION

Meeting of Executive Committee Takes Place of Annual Convention.

While there was no convention of the National District Heating Association this year, the meeting of the executive committee and officers at Cedar Point, Ohio, July 8 and 9, was made the occasion for receiving the reports of the association's officers and standing committees for the year.

It was decided, among other things, that there should be constituted a new committee, to be known as the Committee on Standard Rules and Regulations, to co-operate with the Bureau of Standards and with public service commissions in preparing standard rules and regulations covering the heating business. This committee consists of H. R. Wetherell, Peoria, Ill., chairman, and J. L. Hecht, A. C. Rogers, D. S. Boyden, W. A. Wolls, J. H. Walker, E. L. Wilder, A. E. Duram, F. C. Ross, Thomas Donahue, J. D. Hoffman, N. M. Argabrite, J. C. Hobbs and Secretary D. L. Gaskill.

After receiving the reports of the standing committees the executive committee voted to refer all such reports, excepting that of the Public Policy Committee, to certain members for discussion before publication so that the discussion might be published with the reports.

Before the executive committee adjourned, a resolution was presented by the secretary, Mr. Gaskill, and unanimously passed, expressing the appreciation of the association for the services of S. Morgan Bushnell, a past president of the association, on the occasion of his withdrawal from the district heating business to engage in the insurance business in Chicago.

President George W. Martin announced the following committee chairmen for the coming year:

Educational Committee, J. C. Hobbs, Pittsburgh.
Underground Construction Committee, A. C. Rogers, Toledo, O.
Heating Research Committee, W. A. Wolls, Columbus, O.
Heating Research Committee, D. S. Boyden, Boston, Mass.
Public Policy Committee, W. A. Wolls, Columbus, O.
Accounting Committee, Byron T. Gifford, Grand Rapids, Mich.
Committee on Meters and Accessories, J. H. Walker, Detroit, Mich.
Editorial Committee, D. L. Gaskill, Greenville, O.
Committee on Standard Rules and Regulations, H. R. Wetherell, Peoria, Ill.
Station Operating Committee, J. L. Hecht, Chicago, Ill.

SECRETARY-TREASURER'S REPORT.

The report of the Secretary-Treasurer D. L. Gaskill, showed the association to be in good financial condition while the membership is keeping up in spite of war conditions. The total membership is 363, made up of 167 Class 1 members, 121 Class B members, 15 Class C members, 58 associates and 2 honorary members.

REPORT OF PUBLIC POLICY COMMITTEE.

The subjects covered in the report of the Public Policy Committee included "rate increases in connection with increased cost of production," "uniform formula for figuring required radiation," "special financing required on account of war conditions," "advisability of short-time contracts," "advantages of meter system for hot-water heating," "savings to be accomplished by reducing hot-water heating schedules during certain periods of 24-hour day," and "savings to be made both for hot water and steam systems by economy in the use of heating service."

No uniform formula for figuring required radiation was offered by the committee but the report recommended that the Educational Committee prepare such a rule and that district heating companies seek to have it adopted by the various courts and commissions.

On the subject of the use of hot-water meters the report states:

"It has, until now, been deemed impracticable to sell hot-water service on a meter rate basis. The reasons for this have been partly that the hot-water meters available have had moving elements made of metal which were noisy, and consequently disturbing to the customers; partly there has been the idea that even if a hot-water meter which was not noisy could be developed, it would be necessary also to measure the heat units; in other words, the temperature of the water both entering and leaving the customer's premises.

METERS FOR HOT WATER NOW ON THE MARKET

"It now appears that some of the meter manufacturers are ready to furnish meters for measuring hot water, and that these meters are not objectionable on account of being noisy. Assuming that it is feasible to measure the amount of water circulated through a customer's premises, it is merely necessary to arrive at a fair basis of charge per unit of water circulated through such customer's premises.

"It would appear that there is little more reason why the temperature of the water need be measured at the customer's premises than there is measure the number of heat units per thousand units of gas delivered to a gas customer. Inasmuch as the cost of furnishing the heating service by the utility company depends upon the heat lost in the water between the flow and the return main at the heating company's power station, it would seem perfectly reasonable that a rate of charge per unit quantity of water circulated through the customer's premises should be on the basis of the heat lost per unit quantity of water between the flow and the return main where same leaves the heating company's station.

"This method of charge can further be simplified so that a definite charge per unit quantity of water circulated through the customer's premises can then be made on the basis of the average outdoor temperature over a period of years. Such a method of charge might well be used in conjunction with a primary charge based on the customer's required radiation and also a readiness-to-serve charge, and while such a method of charge may not be an absolutely accurate method such as, for instance, charging for a thousand pounds of steam, it is an infinitely more accurate method of charging than the present flat-rate method, which is comparatively independent of the heat withdrawn from the system by each individual customer.

"In any event, the above-proposed meter method of charging would have the moral effect of largely eliminating the big economic waste which at present exists in connection with central station hot-water heating because of the fact that same is not metered."

Educational Committee Proposes Standard Rule for Figuring Radiation.

A proposed standard rule for determining the proper amount of radiation for a building has been developed by H. R. Wetherell, of the association's educational committee, and is being sent out by the committee for suggestions and comment by the member companies. It is the committee's purpose to develop a formula that will go out as the rule of the National District Heating Association.

The committee points out that the time is coming when heating rates will be made on a "fixed charge plus" basis and where such rates are used, as the fixed charge is based on equivalent direct steam radiation, it is very important to be able to substantiate the formula for figuring required radiation. By adopting the use of "'equivalent required direct radiation," the companies using it have discontinued making comparisons of the customer's steam consumption on the basis of connected radiation, and now reduce their connected load for both direct steam radiation, atmospheric radiation and fan coils to the basis of the required direct steam radiation, and make all comparisons of consumption on this basis.

For the purpose of their monthly reports they also reduce sprinkler tanks, hot-water tanks and cooking apparatus to the basis of direct radiation. It was found in basing a fixed charge on required radiation that it would be rather difficult to substantiate figures on hot-water tanks, sprinkler tanks and cooking apparatus. They therefore planned on having two different heating rates covering the two different classes of service, one for heating only with a, fixed charge based on equivalent required direct steam radiation, plus the consumption charge, and the other rate covering the consumption of hot-water tanks, sprinkler tanks and cooking apparatus which will probably be made with the minimum charge plus a consumption charge, owing to the fact that it is rather difficult to arrive at the demand on such apparatus.

The radiation rule proposed by Mr. Wetherell is as follows:

$$\text{Radiation required} = \frac{\text{B.T.U. lost per hour}}{\text{B.T. U. emitted per square foot of radiation per hour}}$$

Accompanying the rule is a table of B.T.U. losses, the majority being those used by the late Alfred R. Wolff, of New York. Another table compares the values used by different engineers, including American District Steam Company, Hoffman, Snow, Gifford, Wolff and C. R. P. & L. Co.

In using the rule it is assumed that 1 B.T.U. will heat 50 cu. ft. of air 1° F.

Then, with a temperature difference of 80 degrees,

$$\frac{80 \times 1}{50}$$

= 1.6 B.T.U. required to heat 1 cu. ft. 80°.

Good practice, states the committee, allows two changes of air per hour for all leakage losses, and 3.2 B.T.U. are required per hour per cubic foot of space. It has been found that atmospheric radiation will condense 0.21 lbs. of steam per square foot per hour.

0.21 × 965.8 = 200 (approx.) = B.T.U. given off per hour per square foot of radiation.

To compute the radiation required in any room:

First: Compute the B.T.U required to heat the air in the room.

Second: Compute the B.T.U. lost through the doors and windows.

Third: Compute the B.T.U. lost through the walls, floor and ceiling.

For atmospheric radiation, divide the sum of these results by 200 and the quotient is the number of square feet of atmospheric radiation required.

For steam radiation, (1 lb. pressure), divide the sum of these results by 250, and the quotient is the number of square feet of "straight steam" radiation required.

For hot water radiation, (water at 170° F.), divide the sum of these results by 165 and the quotient is the number of square feet of hot water radiation required.

Smokeless Boilers as an Answer to the Coal-Distribution Problem

"Smokeless" boilers, especially those of the down-draft type, designed for burning different sizes of either hard or soft coal, are today occupying a place in the front rank as the answer to the problem presented by the United States Fuel Administration of requiring the supply of anthracite, in a large section of the country to be supplemented by bituminous coal. The difficulties of burning soft coal in the ordinary type of heater are well understood and in both old and new installations it is reasonable to expect that the coming months will see an expansion in the sale of "smokeless" boilers that will mark a new epoch in the history of the heating industry.

Fortunately for the country there are a number of types of "smokeless" boilers which are well suited for complying successfully with the fuel administration's requirements, as well as having economy features that would make them an attractive commercial proposition under any conditions. Following is a list of manufacturers of "smokeless" boilers in the United States, revised to date:

LOW PRESSURE STEAM AND HOT WATER BOILERS.

American Radiator Co., Chicago, Ill.
John Brennan & Co., Detroit, Mich.
Coatesville Boiler Works, Coatesville, Pa.
Jesse C. Coogan, Milwaukee, Wis.
Federal Radiator Corporation, Newcastle, Pa.
Gurney Heater Mfg. Co., Boston, Mass.
Harrisburg Mfg. & Boiler Co., Harrisburg, Pa.
Hart & Crouse, Washington, D. C.
Herbert Boiler Co., Chicago, Ill.
Ideal Heating Co., Oskaloosa, Ia.
Illinois Malleable Iron Co., Chicago, Ill.
Kanawha Mfg. Co., Charleston, W. Va.
Kellogg-Mackay Co., Chicago, Ill.
Kewanee Boiler Co., Kewanee, Ill.
Kroeschell Bros. Co., Chicago, Ill.
Lord & Burnham Co., Irvington, N. Y.
Molby Boiler Co., New York
Newport Boiler Co., Chicago, Ill.
Wm. H. Page Boiler Co., New York.
Peck-Williamson Co., Cincinnati, O.
Peerless Heater Co., Pittsburgh, Pa.
Pierce, Butler & Pierce Mfg. Corporation, New York.
Frank Prox Co., Terre Haute, Ind.
Prudential Heating Co., Akron, O.
Richmond Radiator Co., New York.
H. B. Smith Co., Westfield, Mass.
Spencer Heater Co., Scranton, Pa.
Thompson Heater Corporation, Buffalo, N. Y.
United States Radiator Corporation, Detroit, Mich.
Utica Heater Co., Utica, N. Y.

FIRE TUBE BOILERS.

Ames Iron Works, Oswego, N. Y.
John Brennan & Co., Detroit, Mich.
Brownell Co., Dayton, O.
Casey-Hedges Co., Chattanooga, Tenn.
Freeman & Sons Mfg. Co., Racine, Wis.
Gem City Boiler Works, Dayton, O.
Harrisburg Mfg. & Boiler Co., Harrisburg, Pa.

Hawkes Boiler Co., Chicago, Ill.
Kewanee Boiler Co., Kewanee, Ill.
Murray Iron Works Co., Burlington, Ia.
John O'Brien Boiler Works Co., St. Louis, Mo.
Oil City Boiler Works, Oil City, Pa.
Titusville Iron Co., Titusville, Pa.
Vogt Machine Co., Louisville, Ky.

ACCESSORIES FOR SMOKELESS BOILER OPERATION.

Eureka Smokeless Furnace Co., Chicago, Ill. (Smokeless Furnaces)
Betson Plastic Firebrick Co., Terre Haute, Ind., (Fire Brick)

Newport Adjustable Magazine-Feed Boiler.

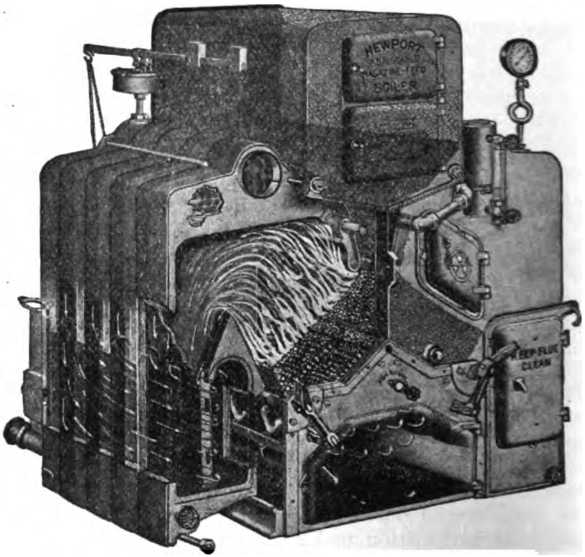
The advantages of the magazine-feed principle in heating boilers is well illustrated in the Newport boiler with its adjustable magazine throat which permits it to burn the various sizes and kinds of fuel. The idea underlying the development of this boiler was to make the advantages of the magazine feed possible in all parts of the country whatever the fuel available, and its performance during the past five years, it is stated, justifies the manufacturers' greatest expectations.

The Newport boiler burns all coals from buskwheat to range anthracite coal, coke and non-caking nut soft coals, separately or mixed. All of these coals are burned on the self-feed principle and it is claimed that even in the case of soft coal it does this with less attention and delivers a more uniform heat than the surface-feed boiler. The adjustable throat is water-cooled and to burn the larger sizes of fuel the throat is extended to form an opening as large as needed for the proper feeding. This adjustment also automatically increases the thickness of the fuel bed to the required depth for proper combustion. To burn the smaller sizes, the throat is readjusted to the narrow opening and the fuel bed is again decreased to the desired depth.

The fuel is automatically fed through the adjustable water-cooled throat onto the sloping grate at the rate required to meet the temperature condition desired and assumes the same slope as the grate, thereby maintaining an even fuel depth. The grate bars are in two pieces so that with a short stroke of the shaking handle only the lower half of the fuel bed is disturbed while with a longer stroke the upper half is also shaken. This, together with the patented grate bar, permits an even cleaning of the grates with one operation.

The Newport is designed so that the maximum amount of heating surface is exposed to the direct action of the fire. The hottest gases first come in immediate contact with the crown sheet and extensive overhanging fire surfaces. The direct fire surfaces are all self cleaning. Special emphasis is laid on the unusual heat-absorbing flue arrangement whereby the flues are located below the fire in the coolest part of the boiler. With this arrangement, it is pointed out, more heat is absorbed from the gases than is possible where the flues are in the hottest part. The flue surfaces are almost vertical and self cleaning.

All water ways, both above the fire and in the flues, are thin, vertical and unobstructed.



SECTION OF NEWPORT BOILER WITH ADJUSTABLE MAGAZINE FEED.

The return water enters the coolest part of the boiler at the rear at a point where they may absorb the greatest amount of heat possible from the flue gases. The supply outlets are located immediately above the direct-heating surface at the front and at the hottest part of the boiler, to promote rapid circulation throughout the boiler and the greatest possible heat absorption.

The boiler is designed so that the magazine is external to the boiler proper. With this arrangement essential heating surface is not sacrificed for fuel-carrying capacity. The magazine capacity it is stated, is double that of any other boiler of this type which makes coaling necessary only once a day in the coldest weather and from two to three times a week in ordinary weather. The ashpit is unusually large and high, being designed to carry several days' acumulation of ashes without danger to the grates.

Another exclusive feature of this boiler is the ashpit spray which sprinkles the ashes to eliminate dust in their removal. Both steam and water boilers are furnished with metal diaphragm regulators which automatically operate the revolving combined draft and check damper in the draft box at the rear.

The return inlets are 4½ in. above the floor level permitting the boiler to be used for heating garages, greenhouses and other isolated buildings. The water line of the largest sizes is only 40½ in. above the floor level.

The Newport boiler is of the cast-iron sectional type and is made by the Newport Boiler Co., Chicago, in a variety of sizes for both steam and water.

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Molby Magazine-Feed Down-Draft Boiler.

A heater that is successfully meeting the requirements for conserving coal and labor is the Molby magazine-feed down-draft boiler, which is designed to burn both anthracite coal of various sizes from pea to stove, and free-burning bituminous coal 2 in. and smaller.

The Molby boiler is built on the down-draft principle of combustion and has two grates, a water grate and a shaking grate practically at right angles to each other. The water grate is formed by water sections with gas ports between and lies along the side of the fire. The shaking grate is at the bottom of the fire and is horizontal. The coal is fed through a magazine at the top of the fire and feeds gradually down into the fire-pot, as the coal is burned away beneath.

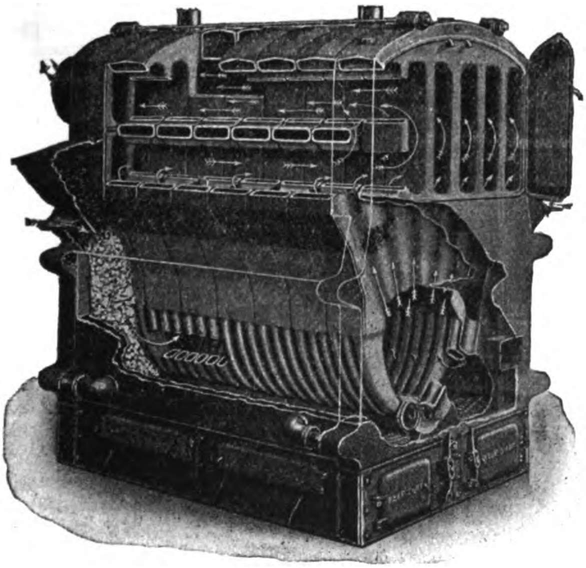
The magazine-feed provides a residue of coal to carry the fire for long firing periods. The draft is taken in under the magazine and the air supporting combustion passes downward and through the fire. As the gases are released from the coal they pass downward and through a water grate to a combustion chamber where in flowing through at a high velocity they are thoroughly mixed and consumed.

The soot and smoke from the coal is consumed by being pulled downwards through an incandescent body of fire and the other combustible and heat-giving products of the fuel are consumed in the fire-box of the heater. The gases burn out into the combustion chamber in a flame and pass over the large heating surfaces of the boiler, to give the greatest possible heat absorption and efficiency.

The fire is always kept opposite the water-grate and above the tops of the gas ports in order to keep the combustion end of the fire and the combustion chamber always at a high temperature. The steam pressure and the temperatures, it is stated, do not drop when coal is added to the fire, but a constant temperature is maintained. For this reason it is never necessary to rush the fire after every firing period to make up the losses through firing and it prevents loss of fuel through unburned gases.

With the down-draft boiler it is necessary to have a tight chimney flue of proper area and height. The boiler should be ample to take care of the load easily. The boiler should be carefully set and cemented to prevent the short circuiting of the gases or the taking in, to the boiler itself, of large quantities of cold air. The air supporting combustion should pass through the fire and through the water-grate. The boiler should receive proper care and attention. Fifty per cent of the labor in attention, however, is saved over the ordinary boiler on account of the magazine-feed feature.

The adjustable magazine feature of the Molby boiler is such that it can be readily adjusted for burning anthracite coal from pea to stove size. Larger sizes of coal than



CONSTRUCTION OF MOLBY BOILER, SHOWING MAGAZINE FEATURE.

this are not desirable for low-pressure heating. The magazine that is suitable for pea coal will not readily feed nut or stove size. In burning bituminous coal only the free-burning variety, the manufacturers state, should be used in a magazine-feed boiler. The best coal is always the cheapest. The results of any installation are proportionately good or bad depending upon the heating value of the coal used and the chimney drafts. The capacity of the boiler depends on the quantity of coal that can be properly consumed. This depends on the size boiler and the chimney draft. A down-draft boiler properly set and with a good chimney, it is stated, provides the highest efficiency and the greatest economy in operation. A boiler of this principle should release and burn the gases thoroughly. The mixing of gas and oxygen is accomplished as the gases pass into the combustion chamber under good draft at a high velocity. The saving of fuel and labor may be such that the installation of one of these boilers becomes an investment paying many times the legal rates of interest on the capital invested.

This heater is manufactured by the Molby Boiler Co., Inc., 101 Park Avenue, New York. The 31-in. and 47-in. sizes have two distinct fire pots and magazines. One side only need be fired in mild weather.

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A Boiler with Two Combustion Chambers and Two Grates.

Among the noteworthy features of construction of the Monarch down-draft smokeless boiler, manufactured by the Wm. H. Page Boiler Co., New York, are *its two combustion chambers and grates, one directly above the other.* The upper chamber is supplied with green bituminous coal which, burning downward through the grate, disintegrates as it ignites, liberating its volatile gases, the resultant incandescent coke dropping upon the lower grate where it continues to burn. Additional air is drawn upward through the lower grate and through this incandescent coke bed where it unites with the gases from the upper grate. In this manner a hot mixture of the proper proportions may be obtained for complete combustion.

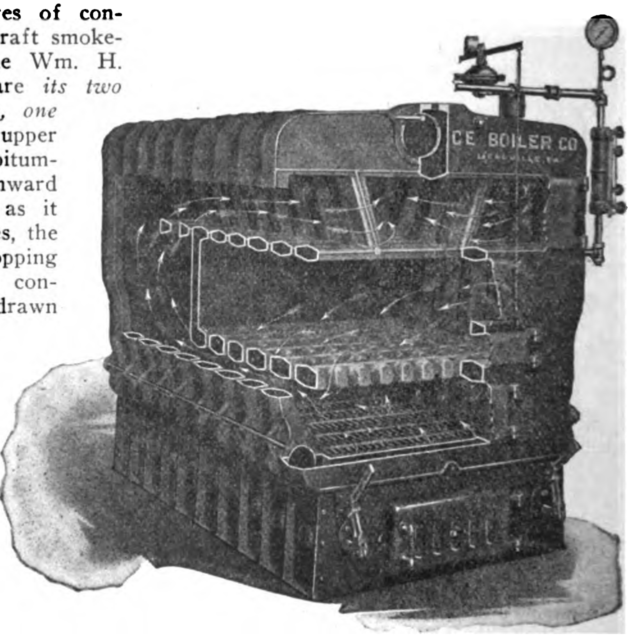
These gases then pass back of the bridge wall section where they turn upward and pass to the front through the two outer boiler flues and again to the rear through the center flue to the smoke pipe, thereby the heat units are absorbed by the heating surfaces of the boiler.

The emission of smoke shows that these rich gases are not being thoroughly consumed, escaping unburned up the chimney, as is evidenced where soft coal is burned in the ordinary up-draft boiler, it being impracticable in such types to supply the rapidly liberated gases with sufficient air pre-heated to the proper temperature to ignite and consume them thoroughly.

The upper grate is cast integral with the boiler section, each bar being hollow the same as the boiler section of which it is a part. The inside area is ample to provide for free circulation and every part is backed by water to prevent its burning. The spaces between the grates and their hollow projections are proportioned to allow for the passage of the requisite supply of air for complete combustion.

The water grate also forms an effective part of the heating surface in the boiler.

In the operation of this boiler no fuel supply is required for the lower or secondary grate, the upper only being charged and an occasional slicing through the openings provided in front section on a level with the grate is all that is necessary to maintain an even fire. The lower grate should be shaken occasionally to relieve it of accumulated ashes.



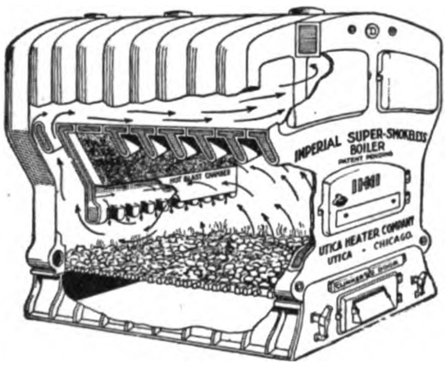
MONARCH DOWN-DRAFT SMOKELESS BOILER.

Imperial "Super-Smokeless" Boilers.

What is described as the latest development in low-pressure cast-iron boiler construction is embodied in the Imperial "Super-Smokeless" Boiler, manufactured by the Utica Heater Co., Utica, N. Y. This boiler, it is pointed out, combines simplicity of construction and design with efficiency, ease of operation with economical results, and elimination of objectionable smoke with the use of even the cheapest grades of coal. It is also adapted for burning hard coal or coke.

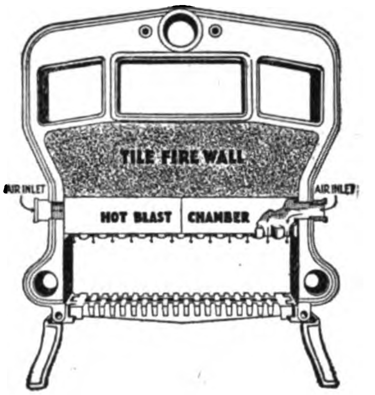
As will be noticed from the illustration, the Imperial "Super-Smokeless" boiler is an up-draft single-grate type of boiler. The rear of the firebox is formed by a hollow baffle or "water curtain" section surfaced with a special high-fire-test cement, which, it is stated, will stand a much higher temperature without fusing than it could ever be subjected to in a heating boiler.

The products of combustion rise in the firebox, coming into contact with the direct overhanging fire surface, thence flow toward the rear and strike against the super-heated surface of the "water-curtain" which serves also to break up many of the soot particles.



CONSTRUCTION OF IMPERIAL SUPER-SMOKELESS BOILER.

As soot and smoke consist largely of carbon, it is important that a high temperature of this carbon and of oxygen be obtained at the moment of union. In the Imperial boiler, this is accomplished by its hot blast chamber. Adjustable inlets on each side of the heater allow cold air to enter at both sides of the boiler. This air, after being intensely heated, is injected into the combustion chamber at a point where it will meet the smoke and soot just as they leave the baffle wall, broken up in a condition where they will readily combine. The manufacturers characterize the result as "the most nearly perfect combustion that has ever been obtained." A white flame is produced which travels through the flues, taking the place of the unburned gases in the ordinary type of boiler. These hot gases in their travel ignite or burn any unconsumed gases, superheat the steam and serve to keep the flue surfaces clean.



TILE FIRE WALL IN IMPERIAL BOILER WHICH SERVES TO BREAK UP SOOT PARTICLES.

These boilers are made in a wide range of sizes for both steam and water.

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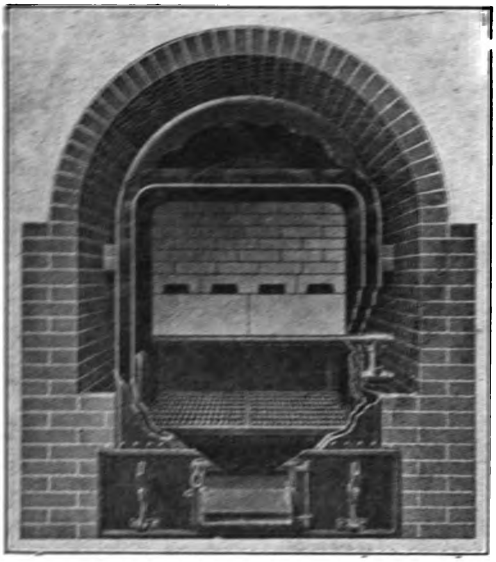
The Use of Intensely Heated Air to Accomplish Smokeless Combustion.

It is times like the present in which nations check up on their extravagant and wasteful methods that give added value, in the eyes of the public, to devices of conservation and increased efficiency. The small percentage of available heat units in a ton of coal which we have utilized, although long a subject of study and discussion by engineers, has been largely ignored by the public. The public has been absorbed in other matters. Money has been comparatively easy to obtain and the public has "muddled through," as a rule, leaving the matter with the engineers.

Smoke with its dirt and waste has been the subject of law-makers and economists for years, but smoke is still with us. Now, however, the situation has changed. The nation must husband its resources of which coal is one of the most important. The nation must cut out losses, both in health and materials, caused by smoke.

Applied science has found the key to the problem in the conditions under which air enters the fire-box of the furnace and how it is handled after it is in there.

Cold air is not burnable. Intensely heated is instantaneously combustible and, when

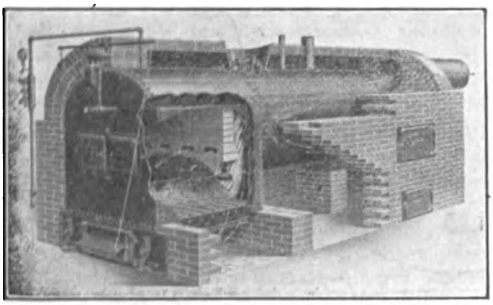


EUREKA SMOKELESS FURNACE INSTALLED IN ORDINARY FIRE-BOX BOILER.

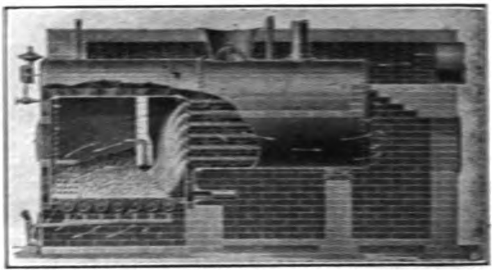
mixed with coal gases, bursts into almost incandescence, so intense is its heat. This is not a new priciple in heating; it is an old one, but one which has been only partially or indifferently applied.

One device which harnesses this law into workable form is the construction of the fire-box interior, known as the Eureka smokeless furnace. This device has been on the market for the past three years and the manufacturers state that the severest comparative tests by engineers and architects has produced increased proofs of the value of the device for the better utilization of coal and the prevention of smoke in soft coal combustion.

It will be noted in the construction of this furnace, which is shown in the accompanying illustrations, that the hot air is not only distributed over the coal bed, but is also injected into the gas chamber back of the hollow Eureka fire-wall, where all the gases become ignited and consumed at a high temperature, before entering the boiler tubes.



EUREKA SMOKELESS FURNACE IN OPERATION.



ARRANGEMENT FOR ADMITTING SUPERHEATED AIR TO COMBUSTION CHAMBER OF EUREKA SMOKELESS FURNACE.

This device is manufactured by the Eureka Smokeless Furnace Co., Chamber of Commerce Building, Chicago, Ill., and the company writes that engineers and architects have a great opportunity to make a decided "hit" with their clients by specifying the Eureka smokeless furnace for their clients' use.

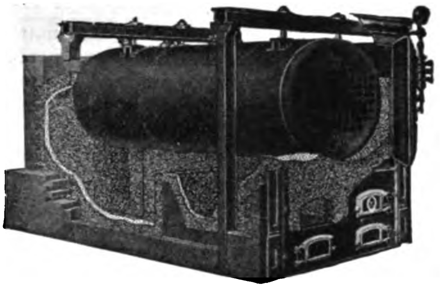
Plastic Fire Brick as a Substitute for Blocks or Bricks Requiring Mortar.

In view of the scarcity of brick blocks considerable interest attaches to the use of Betson's plastic fire-brick for making boiler furnace linings. This product is described as superior to blocks or bricks which require mortar and which are likely to fall out, permitting air in leakage.

BETSON'S PLASTIC FIRE BRICK BEING APPLIED WITH MALLET. IT IS SMOOTHED WITH A TROWEL.

[illegible] heating boilers, as well as for other kinds of boilers, plastic fire-brick has been found to be a money-saver. It is especially designed for forming jointless, one-piece furnace linings in new or old settings. It is made of selected refractory materials and is subjected to a special mechanical preparation to eliminate expansion and contraction from temperature changes, thus making solid monolithic linings possible. It comes in barrels in a moist, plastic condition ready for use.

A further advantage of this product is that anyone can apply it, as it is an easy matter to make the forms, while sometimes forms are not needed. After taking out the former lining of fire brick, a lining of Betson's is built up to the same thickness by placing it in chunks, consolidating it with a mallet and smoothing with a trowel. After a few hours' drying with a light fire, the lining is ready for regular hard service.



BETSON'S PLASTIC FIRE BRICK AS USED FOR LINING OF FURNACE OF RETURN-TUBULAR BOILER.

The complete Betson lining has no joints to leak air and gases, no fire clay or mortar to break and fall out and no bricks or blocks to crack or spall. Injuries to side walls by firing tools, it it added, do not weaken the lining as a whole and are easily patched. This material is also used as a substitute for special forms of bricks or blocks as, for example, where the front headers of horizontal water-tube boilers rest upon the front arch. It is also used for front arches, side walls, bridge walls, rear arches, and baffles. The manufacturer is the Betson Plastic Fire Brick Co., Rome, N. Y., and the company states that its product is carried in stock in all of the principal cities of the United States and can be obtained quickly.

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House Heating with Kerosene.

Heat Your House with Kerosene is the advice contained in a circular issued by the Doble-Detroit Steam Motors Co., Detroit, Mich., devoted to the Doble system of heating with kerosene oil. This system is designed to burn liquid fuel in an atomized condition. It can be used, it is stated, in any type of house-heating apparatus. The apparatus consists of a small combustion chamber, which is placed in the ash-pit space of the furnace. A cast-iron pipe bolted to the combustion chamber projects through the ash pit opening. The blower assembly is bolted to a flange on the cast iron pipe connecting with the combustion chamber.

The motor to drive the blower is bolted to the blower casing. A small float chamber alongside of the blower receives the fuel by gravity from a tank which may be placed in any convenient position in the cellar. By arranging the tank near a window it can be filled from outside the house.

A small pipe line from the fuel tank conveys the fuel by gravity to the float chamber.

A connection from any electric light socket furnishes current for the motor which drives the blower. The blower takes air through the inlet opening and feeds the air at high velocity through the outlet passage of the blower. In the outlet passage a fuel nozzle is located, the stem of which is connected with a pipe from the float chamber. As the forced draft of the blower rushes through the fuel nozzle it draws the fuel from the float chamber and feeds a continuous spray of oil into the combustion chamber. The fire is started by a gas pilot light located in the combustion chamber.

A thermostat, placed in one of the upper rooms, regulates the fire according to the desired temperature. When the room temperature reaches the point at which the thermostat is set to operate, the electric circuit to the motor is broken so that the blower stops feeding fuel into the combustion chamber and the fire goes out.

When the room temperature drops and the thermostat again makes the electric contact to the motor, the fuel is ignited by the small pilot light in the bottom of the combustion chamber.

The fire is therefore turned on and off automatically, depending upon the variation of the room temperature, and requires no attention after the first lighting of the fire.

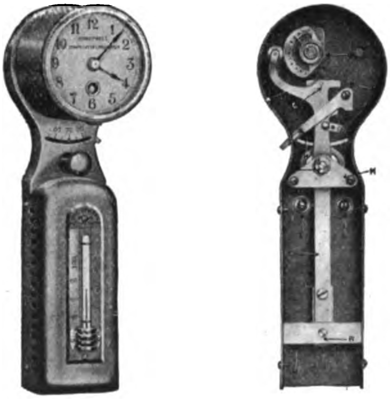
The circular also gives some cost figures compared with coal, taking 1 lb. of coal at 10 000 B. T. U. and 1 lb. of kerosene at 19,832 B. T. U. On this basis the cost of 15 tons of coal at $10.50, together with the care of the furnace and removing ashes during six months, would come to $217.50. For the same period and service 1793 gal. of kerosene at 12 cents per gallon would be needed. This would come to $215.16 to which should be added electric current for six months amounting to $12.00, or a total cost of $227.16.

Automatic Draft and Temperature Regulation a Cure for Fuel Waste.

Very few house holders really enjoy the maximum economy and efficiency of their heating plants. Many owners think they are getting the most out of the fuel they burn, but have been greatly surprised at still further fuel economy that they have accomplished by the use of a more sensitive method of regulating the burning by the constant supervision of the draft adjustments. This is possible by the thermostatic system of draft regulation.

SPRING MOTOR USED WITH HONEYWELL SYSTEM OF AUTOMATIC DRAFT AND TEMPERATURE REGULATION.

Fuel waste in burning occurs during those forgotten periods when some one leaves the drafts a little too long or doesn't turn them on soon enough to meet the changing condition of the weather. Too much air through the fire will speed it up and it soon gains in momentum. Its lively burning will either rapidly consume all the fuel in the fire pot or require more to be thrown on, so that a large quantity of fuel and heat is unnecessarily used before the fire is reduced to the normal rate of burning.



Front. Back.

EIGHT-DAY CLOCK THERMOSTAT USED WITH HONEYWELL SYSTEM OF AUTOMATIC DRAFT AND TEMPERATURE REGULATION.

Again, when the weather turns cold and drafts are not turned on promptly enough, the fire may smolder low and even go out, requiring additional unnecessary quantities of kindling and coal to rebuild the fire, with discomfort in the meantime.

The automatic temperature regulator establishes a thorough co-operation between outside weather and inside temperature and the rate of burning fuel. The temperature regulating devices offered today on the market have reached a very high degree of perfection. They have many very desirable features, such as turning off the drafts in the evening and turning them on again in early morning so that the house shall be comfortable at rising time.

The motors which operate the dampers are made to run by gravity, clock spring, or electricity. The present-day thermostat which regulates the temperature in the rooms and telegraphs the orders down to the motor operating the drafts of the boilers, are exceedingly accurate and efficient. A difference of one degree in the temperature of the room from that required by the thermostat will affect its sensitiveness and turn on the drafts so that the fire in the boiler may catch up.

The installation of automatic draft regulation on any boiler or furnace is a guarantee of fuel savings. The selling of such devices as these this year is in accord with the suggestions of the United States Fuel Administration which in its bulletins emphasizes very strongly the great benefits of automatic draft and temperature regulation.

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Marvel Motor Valve.

The accompanying illustration shows the Marvel Motor Valve, described in the Au-

MARVEL MOTOR VALVE

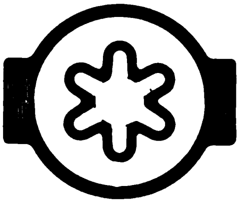
gust issue, for radiator and valve control. It is made by the American Thermostat Co., Newark, N. J., and consists of a Gorton type quarter-turn packless cone valve to the post of which is directly connected the master Marvel Valve Motor, non-reversing and universal, operating on either alternating or direct current of 110 volts. Where steam or hot water circulation is constant, it is possible with the device to control individual radiator units or a connected system of units when used in connection with the company's system of temperature regulation.

◆

Heating Garages by a New Method.

What is described as the first successful device by which a garage can be heated by hot water from a steam or vapor boiler located in the residence, has been brought out by the Excelso Specialty Works, Buffalo, N. Y. The Excelso method, as it is called, is also used with success in heating water for domestic use with or without thermostatic control. Its cost is said to be far less than installing a coil and manhole in a storage tank. It can also be used with or without the storage tank, either singly or in multiples.

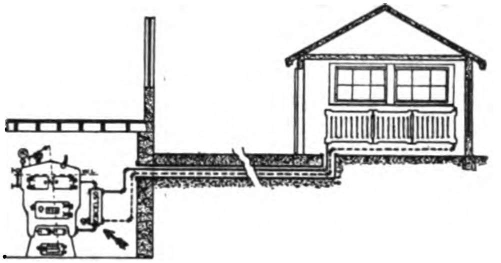
EXCELSO WATER HEATER.



SECTIONAL VIEW OF EXCELSO WATER HEATER, SHOWING INTERIOR CONSTRUCTION.

The Excelso water heater itself is a one-piece casting having two separate chambers. It has an inner wall of corrugated form to give extended heating surface. The water circulates through the outer chamber and is heated by steam or boiling water in the inner chamber.

For heating garages an important feature of its usefulness is in such cases where direct underground steam lines to the garage are higher than the water-line in the boiler. Where such conditions are met the heater may be connected to the residence boiler and the hot water pipes run underground to the garage radiation, using either city pressure, an expansion tank in the house or garage, or loops. Users are advised to install at least one heater below the water-line of the boiler in the residence. If additional capacity is required it may be installed above the water-line and live steam used to heat the water. This method of installation, it is pointed out, prevents freezing, because the heater installed below the water-line is always working even though there is no steam in the boiler or the fire is banked.

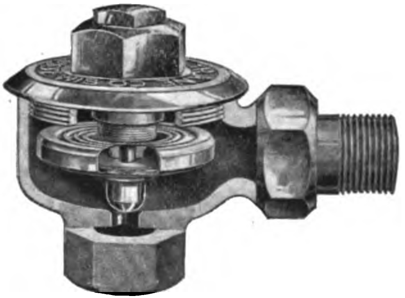


TYPICAL INSTALLATION OF EXCELSO METHOD FOR HEATING GARAGE.

The heater is made in four sizes. Where steam at 5 lbs. pressure is used and the water is heated from 45° to 155° during a three-hour period the tank capacities of each heater range from 40 gal. to 400 gal.

◆

New Features Embodied in Trane Thermo Traps and Vents.



CONSTRUCTION OF TRANE THERMO TRAP, SHOWING SELF-ALIGNING STEM INSIDE DIAPHRAGM.

A steam trap which is being widely used for new installations and especially for remodeling work in factories, is made by the Trane Co., La Crosse, Wis., and is known as the Trane thermo trap. A unique feature of this valve, which is shown in Fig. I, is its distinct type of diaphragm which is self-aligning, as well as adjustable. The expansion member is a 2 in. metal diaphragm made of phosphor bronze. It is filled with a sensitive liquid which leaves the diaphragm normally compressed and gives a maximum expansion of about 3-16 in. The self-aligning stem inside the diaphragm serves to prevent the stem from getting out of alignment either on the job or through rough handling in shipping besides giving assurance that the plunger will seat properly when the job is in operation.

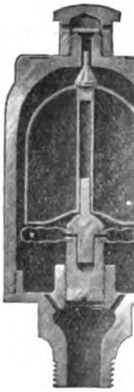
Another notable feature of this trap is the outside adjustment by which any desired readjustment may be secured while the system is in operation by removing the plug on top of the valve and, with a screw driver, turning the diaphragm to any position.

The seat in the Trane trap is beveled and is below the floor of the trap which slopes down to it on all sides, making it self-cleaning. The action of the diaphragm is described as quick and positive.

Trane Exhaust Air Valve and Float Vent Trap.

A new device known as the Trane air exhaust valve has recently been developed by the Trane Co., replacing the thermo trap used on top of the Trane receiver. It is found that its design makes it better adapted for venting large volumes of air freely and preventing the escape of steam.

The valve is made with the well-known Trane phosphor-bronze diaphragm with the valve seat on top. The long plunger motion accounts for the free venting of large volumes of air. While there is little resistance to the escape of air past the aluminum disc resting on a seat, it serves as a check in preventing air from passing back into the system.



SECTION OF TRANE FLOAT VENT TRAP.

To meet the demand for a valve which will prevent the escape of water, besides accomplishing all that the air exhaust valve does, the company has developed a device known as a float vent trap. A valve of this kind is useful in places sufficiently above the water-line to make the volume secured by the use of a receiver unnecessary. Also vapor systems for disconnected garage buildings with overhead systems, no basements, etc., can be better designed by using a valve of this kind. It is also valuable for improving the operation of poorly-designed, straight steam plants by connecting it on the end of the main return.

This valve has simply the sliding float in addition to the features of the air exhaust valve.

As shown in the illustration the large brass float with the hollow tube rest and slides upon the diaphragm pin so that the float can rise independent of the diaphragm or be forced up by it to close the plunger against the seat. Either steam striking the diaphragm, or water lifting the float will close the valve. Air has easy passage through the large ports for venting. The aluminum disc is used here also to prevent air entering the system.

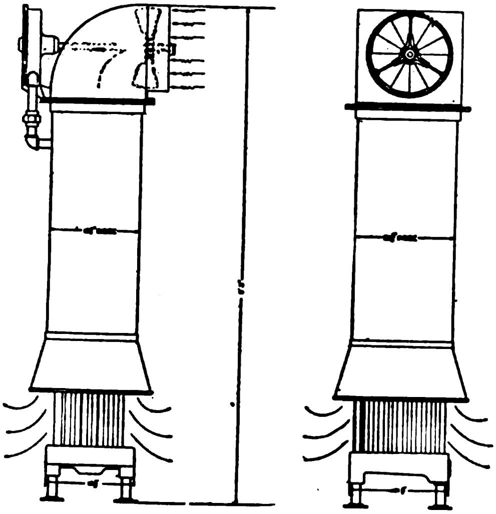
◆

Unit Portable Hot-Blast Heaters.

In discussing the use of unit hot blast heaters, at the recent summer meeting of the heating engineers' society, a description was given of the "ABC" unit heater. This heater is so built that air from within the room can be recirculated or a pipe can be attached to extend through the wall or through the roof to heat and circulate fresh air. The heaters are especially useful, it is stated, for heating additions to buildings where it is not practicable to extend the main heating system and for similar special cases.

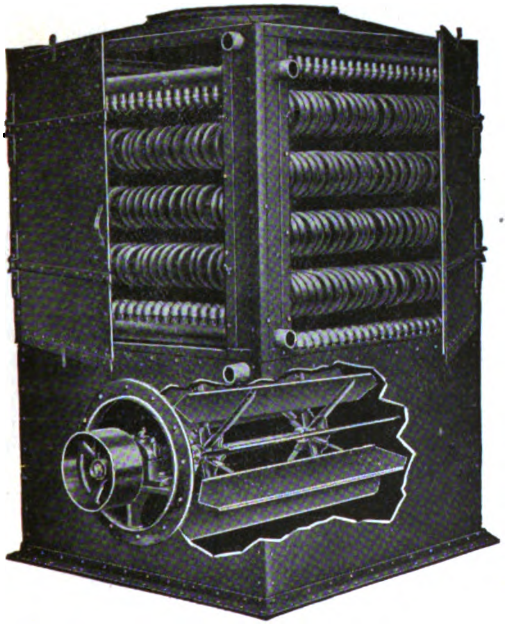
The base of the heater is divided by a partition in the center, making two separate chambers, one for the live steam side, the other for the return. There is an internal water-seal at one side of the base to prevent the steam from blowing into the return side before passing through the pipes. Into the top of this base is screwed a nest of steam pipes which are built up in return loops. The disc fan at the top is driven by a small impulse turbine mounted on a bracket outside the jacket. Steam is admitted to the intake of the turbine and passes from the turbine and exhaust pipe into the heater base, thus using the steam for heating.

These heaters, which are made by the American Blower Co., Detroit, Mich., are furnished in capacities ranging from 1790 to 2070 C. F. M. with corresponding B. T. U. per hour of 180,000 to 236,000, and with



ABC UNIT HOT-BLAST HEATER.

steam pressures ranging from 40 to 100 lbs. gauge. Where desired the fan may be driven by motor or by belt.



BAETZ AIR HEATER, SHOWING FAN AND HEATING COILS.

Another type of unit heater described at the same meeting is the Baetz air heater, manufactured by Skinner Bros. Mfg. Co., St. Louis, Mo. As will be noticed from the illustration this heater is constructed of steel plates and angles. The upper part is occupied by coils of steam pipe, arranged so that they may readily be removed for repairs. A blower is placed beneath them in the same enclosure. Air is drawn in by the fan from two sides and is forced upward against the steam-heated coils, passing out at the top as heated air. A convenient line shaft, a small engine or a motor may be used to propel the fan. The illustration shows where the steam and return connections are made. The point is made that when a small steam engine is used for driving the fan the exhaust steam from the engine can be piped direct into the heater coils.

STURTEVANT UNIT HOT BLAST HEATER.

The Baetz heaters, it was stated, are in successful operation in many large foundries and industrial plants.

Still another type of unit heater, not described at the meeting, is manufactured by the B. F. Sturtevant Co., Hyde Park, Mass., and is also illustrated herewith. This unit is equipped with a turbine-driven disc fan and discharges the heated air at the bottom along the floor. It is especially recommended for heating shops, roundhouses, and industrial buildings. The Sturtevant individual heater unit requires but one steam pipe and is arranged so that the exhaust steam from the turbine may be used in the coils.

This heater consists of a disc fan mounted on the top of a sheet-metal casing and arranged to discharge the air down across Vento radiation enclosed in the casing. The outlet discharge is at the bottom and is designed to discharge the air in a horizontal direction along the floor.

The fan is arranged for operation by a direct-connected motor, direct-connected steam turbine, or by pulley for belt drive. The fan wheel is of the multi-blade type, disc fan 26 in. in diameter. The capacity at 2,020 r.p.m. is 6650 c.f.m. The heating surface consists of 376¼ sq. ft. of 40 in. American Radiator Vento which will heat the air from an entering temperature of 60° F to a final temperature of 128° F., causing the condensation of approximately 500 lbs. of steam per hour, steam entering the heater at 5 lbs. pressure.

◆

Steam Traps as Fuel Savers.

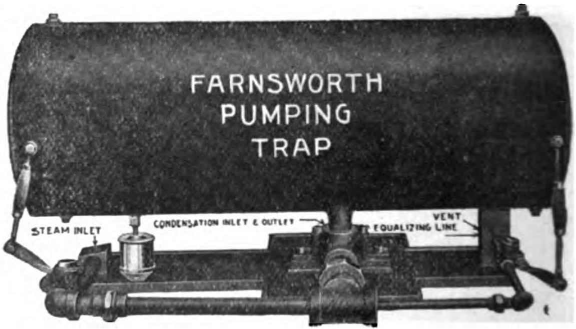
Some interesting examples of coal saving by the use of steam traps and similar appliances are reported by the Farnsworth Co., of Conshohocken, Pa., manufacturers of the Farnsworth line of condensation utilities. In one paper mill the use of these devices, it is stated, has increased the production and decreased the coal consumption about 4000 tons per year, while in one textile mill four tons of coal per day were saved out of eleven tons formerly burned. Farnsworth apparatus, it is stated, is being successfully used in nearly all of the large Government camps, especially in the camp laundries where duplex boiler feeders are installed for draining the high-temperature condensation and feeding it directly into the boilers, and pumping condensation under various conditions. In many such plants the condensation is being fed into the boilers at temperatures over 300°.

In this particular machine one chamber is always in a receiving condition while the other chamber is always under boiler pressure. It is usually placed on top of the boiler or in any convenient place above the water-line of the boiler. All of the high-pressure traps discharge through one common return directly to this duplex boiler feeder. The alternate filling of the receiving chamber and the delivery of condensation from the delivery chamber operates the control valve of the machine which feeds the water into the boilers. This method provides a closed system between all high-pressure traps and the boiler, serving to hold the condensation that is in the high-pressure traps under pressure, thus retaining the heat units.

Should any of the high-pressure traps leak, there would still be no loss as the steam or condensation would only be discharged into the closed return line.

When the same plant is serving a heating system the company recommends the use of its duplex condensation pump which is designed to drain the condensation from the low-pressure heating mains, or heated apparatus of any kind, and to pump this condensation directly into the receiving chamber of the boiler feeder, along with the condensation from the high-pressure traps. In operation the receiving chamber of the condensation pump is equalized with the heating system or heated apparatus, return lines, etc. As the chamber fills it oscillates and operates the control valve which, in turn, applies full boiler pressure on the top of the low-pressure condensation. This, of course, pumps the condensation out and into the receiving chamber of the duplex boiler feeder.

The company's complete line includes condenser vacuum pumping machines which are remarkable for the high vacuum they maintain, making them adaptable for clearing sluggish return lines or for pulling condensation out of blast coils where there is frequently a tendency toward vacuum, due to the cold air being blown over them, which holds back the condensation in the coils.



FARNSWORTH PUMPING TRAP, ILLUSTRATING THE FARNSWORTH STEAM TRAP PRINCIPLE.

The company also manufactures several types of single-acting pumping traps and variable-pressure traps which form a combined separating and pumping trap, also separating traps for draining high-pressure steam lines and heating apparatus. The Farnsworth high-vacuum separating trap, the company states, is doing excellent work draining lines carrying a high vacuum between the engine and condenser. In the use of these traps it is possible not only to collect this condensation under a high vacuum, but to pump it to any point of use with a high-pressure steam connection.

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New Publications.

Friction of Water in Pipes and Fittings, by Professor F. E. Giesecke, head of Division of Engineering, Bureau of Economic Geology and Technology, University of Texas, has just been published and will rank as one of the most important publications of the year for the heating engineer. The bulletin describes in detail a series of experiments made at the University of Texas to determine the friction of water in pipes and fittings, with particular reference to the application of the developed data to the design of hot-water heating systems. The experiments described show that the friction of water decreases as the temperature of the water increases and that, for ordinary ranges of temperature, the friction of water in one foot of new and clean black pipe is

$$\frac{0.01533v^{1.77}}{t^{0.19}\,d^{1.275}}$$

feet of water of the same temperature as that flowing through the pipe; t being the temperature of the water in Fahrenheit degrees, v the velocity of the water in feet per second, and d the internal diameter of the pipe in inches.

The experiments also show that the friction of water in galvanized iron pipe is slightly greater than that in black pipe, that it is somewhat greater in used pipe than in new pipe; that the friction in drainage elbows is considerably greater than in ordinary elbows, and that the relation between the friction in short radius and that in long radius elbows is quite variable; that the friction due to unreamed ends is relatively much greater in small pipes than in large pipes, and other interesting facts.

A copy of the bulletin may be secured by writing the chairman of the Committee on Publications, University of Texas, Austin, Texas.

Analysis of Mine and Car Samples of Coal Collected in the Fiscal Years 1913 to 1916, are given in Bulletin 123, issued by the Bureau of Mines, being a continuation of the reports on the sampling and analyzing of the coals of the country begun by the government in 1904. It is the third of the series. Bulletin 22, "Analyses of Coal in the United States," which can now only be obtained from the Superintendent of Documents, Government Printing Office, Washington, D.C., for 85 cents, is the first. The second bulletin of the series, Bulletin 85, "Analyses of Mine and Car Samples of Coal Collected in the Fiscal Years 1911 to 1913," is still available for distribution by the Bureau of Mines. Copies of Bulletin 123 may be obtained free of charge by addressing the Director of the Bureau of Mines, Washington, D. C., as long as the present edition remains.

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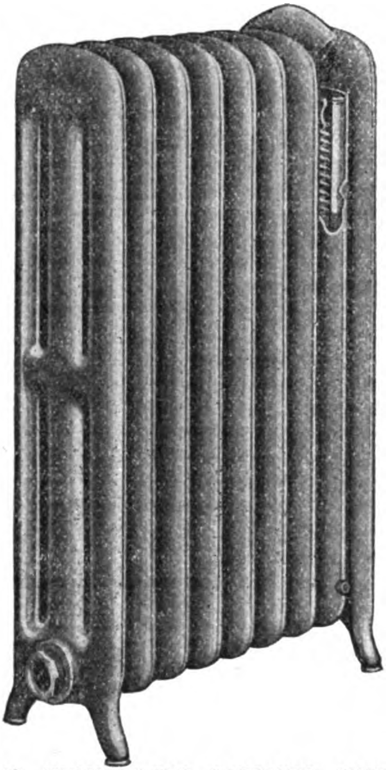
Trade Literature.

Trico Humidifier, consisting of a reservoir or water container to be located directly above a radiator, is featured in a new catalogue entitled "Humidity," issued by the Art Metal Radiator Cover Co., Chicago. This device it is stated, may be adjusted to fit any radiator. It is made of galvanized metal, is 1¼ in. deep and extends over the entire length and width of the radiator. It is made so that part of the hot air passes through perforations in the side of the container near the top and thence over the water's surface, carrying the rising vapor through an aperture in front. The art metal top is made of No. 12 gauge pickled steel. Exact imitation of any wood desired is furnished. The container is filled with water by hand through a butterfly trap at one end.

G. F. E. Rector System Data Sheets, prepared by the Gas Heating Department of the General Fire Extinguisher Co., Providence, R. I., and having special reference to the G. F.E. Rector system of gas-heated radiators, are a noteworthy contribution to recent heating literature. Those published up to date comprise some 49 sheets and cover, in addition to details of the Rector system, methods of estimating for the installation of this system, computation of gas consumption, selection of radiation, installation of radiation, piping (general), gas piping, vacuum piping, and gas valve adjustment. The data sheets supplement the company's catalogue on "Heating de Luxe Made Plain," which is a technical explanation, with illustrations, of the G. F. E. Rector system. A special binder is furnished for the data sheets to hold additional sheets as issued.

Roral Humidifying Radiator Section is a unique device made by C. C. Shipp & Co., Indianapolis, Ind., and described in one of the company's recent circulars. It is practically a removable-top humidifying radiator section. It holds 10½ lbs. of water which evaporates into the air of the room through a slot in the removable top or cap. In addition to the humidifying section itself, the company uses a device known as the D-1 automatic supply and air release which is designed to eliminate the need of an air valve on the radiator, automatically controlling by its own action the circulation of steam through the sections of the radiator. The operation of this valve is intended to constantly withdraw steam from the live sections of the radiator and condense it by means of a condensing coil, thus keeping all sections filled with live steam.



RORAL HUMIDIFYING RADIATOR SECTION, SHOWING AUTOMATIC SUPPLY AND AIR RELEASE VALVE SUBMERGED-

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War Savings Societies.

Our readers have been invited to "back up" our soldiers at the front by joining or forming a War Savings Society. Full information will be supplied upon addressing the War Savings Society Bureau, 51 Chambers Street, New York City, or the National War Savings Committee, Washington, D. C.

How Much Money Does a Soot Cleaner Save?

Some interesting computations have recently been made by the Vulcan Soot Cleaner Co., Du Bois, Pa., showing that a soot cleaner saves more money during its lifetime than is generally supposed. The computations have been simplified to "savings per feet of pipe." Thus they show that each foot of pipe used in connection with a permanently-installed soot cleaner saves approximately 18.3 tons of coal during the lifetime of the cleaner. In addition, each foot of pipe saves one man's labor for one day. If we assume the price of coal to be $4.00 per tone and 200 ft. of pipe per cleaner, the money saved for the lifetime of the cleaner will be $4.00 x 18.3 x 200 = $14,600. Add to this the boiler-room labor wage ($2.00 per day x 200 days, the average life of the cleaner) and we get a total saving of $15,000. These figures are based on boilers operated at 140%, average coal consumption 4 lbs. per B. H. P. per hour, boilers operating 24 hours per day, 325 days per year.

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New York Steam Company in Receivers' Hands.

As a result of war conditions, resulting in the greatly-increased cost of materials, the New York Steam Company, which supplies steam for power and heating purposes in both the uptown and downtown districts of New York, has been placed in the hands of receivers. Those named are G. C. St. John, former president of the company; George F. Hurd and William P. Fitts. The receivership was the direct result of a mortgage foreclosure suit brought by the Andrews Institute for Girls at Willoughby, O., which is one of the principal owners of the company.

In the order appointing the receivers Judge John C. Knox of the Federal District Court said:

"The New York Steam Company is presently unable to meet and discharge its obligations which have already matured and those which are maturing. It is unable to carry on its ordinary business with safety to the public and advantage to its stockholders, and it is in the intereset of the defendant steam company and the bondholders, creditors and stockholders of the defendant company that receivers of all its property and assets be appointed."

The liabilities of the company are said to total, roughly, $4,750,000 of bonded indebtedness and $800,000 in accounts payable. Current assets are given as $801,357.16, and liabilities, including mortgages and current debts, as $5,919,206.07.

It is expected that the present organization will remain intact and the business continue as heretofore.

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Business Still Lives!

The supreme factor in American business today is the government. Through its power to regulate the distribution of fuel and materials it controls practically all the industrial activity of the country. Through its military and industrial powers it affects all labor. By price-fixing it controls mining and important agricultural operations. By licensing and priorities it controls traffic on both land and sea. It operates railways, shipyards, munition plants. It owns navy yards, armories, gun factories, powder plants, a security-issuing corporation.

An unprecedented degree of the power of industry has, because of a people's passion for victory, been willingly given up to those in authority over us. Yet business lives. The government desires it to live. The government calls upon it to preserve, to strengthen its own organizations. The government urges it, not only to make its voice heard now, but to take serious counsel regarding the future.

This work has begun. Parliaments of business are gathering daily at Washington. Upon the calendar of their deliberations is written: First, how can we help win the war? Secondly, what is our program, once the day of victory has come?—*Harry A. Wheeler in the Nation's Business for August.*

◆

Deaths.

William A. Myler, secretary-treasurer of Standard Sanitary Mfg. Co., Pittsburgh, Pa., died at his summer home, Patterson Heights, Pa., July 25, after several months' illness. He was 66 years old. Mr. Myler was one of the organizers of the Standard Sanitary Mfg. Company and was prominent in Pittsburgh social and philanthropic circles.

P. Francis Corcoran, secretary of the Hoffman Specialty Co., Chicago, died July 30 at the American Hospital, Chicago, following an operation for appendicitis. Mr. Corcoran was but 26 years old, but had already made a place for himself as an executive of ability and was a well-known figure in Chicago heating trade circles. He had been connected with the Hoffman Specialty Company since 1913.

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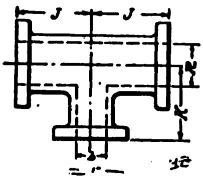
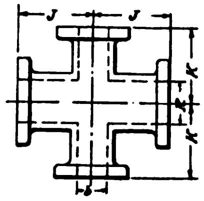
Errata.

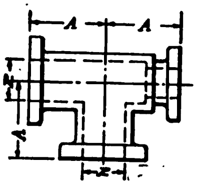
The attention of readers is called to a transposition of illustrations in Standard Data Sheet No. 17-D (published in the August, 1918, issue) listing "Standard Bull-Head Reducing Tees and Crosses, Flanged" These illustrations are reproduced herewith in their correct order.



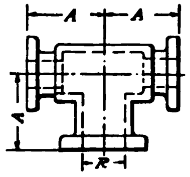
Reducing Tee.



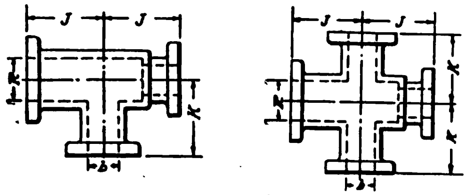
Reducing Cross.



Reducing-on-Run Tee.



Bullhead Tee.



Reducing-on-Run and Branch Tee and Cross.

Keep Your Liberty Bonds

HOLD to that bond. You invested to help send the boys across. They are over now, at grips with the German monster. You expect them to hold on—hold on till the last vestige of autocracy is crushed out of him. Then you, too, must hold on—must keep your enlisted dollars invested on the fighting line.

It isn't the hooray of a campaign that wins a war. It's the will to hang on, to make sacrifice today, that tomorrow may bring victory.

And your investment. Those bonds are the safest investment you ever made. Don't be lured into exchanging them for the "securities" of some suave get-rich-quick operator. Big returns may be promised but the bigger the promised returns the bigger the risk.

If you have to have money, take your bond to any bank and use it as collateral for a loan. There is no security the banker would rather have—nothing on which he will lend more willingly.

Don't use bonds to buy merchandise. The average merchant, accepting your bond in trade, sells them immediately, thus tending to lower their market price and taking away from the buyer of your bond the ability to lend a corresponding amount of money to his Government. Liberty Bonds are meant to help your country at War; are meant for investment and to provide an incentive for saving and a provision for the rainy day.

Hold fast to your Liberty Bonds. Hold fast for the sake of the boys "Over There." Hold fast because it is good business.

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THE HEATING AND VENTILATING MAGAZINE

SIZING OF DUCTS AND FLUES—METHOD NO. 7.

(B. F. Sturtevant Co.)

Note.—For explanation and example assumed see Standard Data Sheets Nos. 10-M and 10-N.

The Sturtevant Co. uses a method of sizing ducts and flues based on equivalent pipes—usually 5-in. pipes being used. For school house and public building work velocities are used ranging from 1000 ft. per minute minimum to 1500 ft. per minute maximum. For the example here assumed a velocity at the fan of 1000 ft. per minute has been adopted, although for factory buildings this velocity is increased to 2000 to 2400 ft. per minute.

In this system there are sixteen outlets each to deliver 1500 C.F.M. This gives a total volume of 24,000 C.F.M. With a velocity of 1000 ft. per minute, the area of the pipe at the fan outlet would be 24 sq. ft., or 3456 sq. in. The next size round pipe to this would be 66 in. in diameter. In practice a pipe is used whose diameter is an even number of inches, that is, fractional sizes are disregarded. While not absolutely accurate, this method is close enough because two different men, building the same size of pipe would vary the friction considerably, depending upon the care which they used in forming the joints.

The equivalent 5-in. pipes for ducts and flues of various diameters shown herewith in Table I.

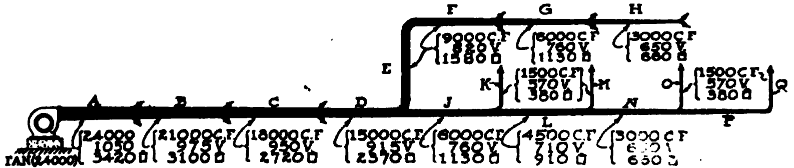
TABLE

Diam. of Pipe In.	Equiv. 5in. diam. Pipes	Diam. of Pipe In.	Equiv. 5in. diam. Pipes	Diam. of Pipe In.	Equiv. 5in. diam. Pipes	Diam. of Pipe In.	Equiv 5in. diam Pipes
5	1	29	79	53	365	77	931
6	1.6	30	88	54	378	78	961
7	2.3	31	96	55	400	79	992
8	3.2	32	103	56	414	80	1024
9	4.3	33	109	57	444	81	1056
10	5.7	34	119	58	458	82	1089
11	7	35	127	59	475	83	1122
12	9	36	138	60	499	84	1156
13	11	37	146	61	514	85	1191
14	13	38	157	62	538	86	1226
15	16	39	170	63	560	87	1262
16	18	40	179	64	587	88	1298
17	21	41	191	65	604	89	1336
18	24	42	204	66	630	90	1374
19	28	43	215	67	658	91	1413
20	32	44	228	68	678	92	1452
21	35	45	240	69	708	93	1492
22	41	46	253	70	730	94	1532
23	47	47	269	71	763	95	1573
24	50	48	282	72	786	96	1615
25	55	49	298	73	814	97	1657
26	62	50	316	74	843	98	1707
27	68	51	329	75	871	99	1744
28	74	52	349	76	901	100	1788

SIZING DUCTS AND FLUES—SEVENTH METHOD (Continued)

From this table it is seen that a 66-in. pipe is equivalent to 630-5-in pipes. 24,000 C.F.M. ÷ 630 = 38 cu. ft. per 5-in. pipe, equivalent to 1500/38 = 39.5 5-in. pipes, the required size of each outlet. From the table it is seen that it is very nearly equal to a 22-in. pipe. The equivalent number of 5-in. pipes for two outlets would be 79; for 3 outlets, 118½; for 4 outlets, 158; for 5 outlets, 197½; for 6 outlets, 237. for 7 outlets, 276½; for 8 outlets, 316; for 9 outlets, 355½; for 10 outlets, 395; for 11 outlets, 434½; for 12 outlets, 474; for 13 outlets, 513½; for 14 outlets, 553; for 15 outlets, 592½.

This gives a schedule of duct and flue sizes as follows:



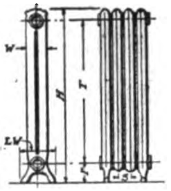
SIZES BY METHOD NO. 7

Duct or Flue	Length	Cu. Ft. per Min.	Dia. In.	Area Sq. In.	Velocity Ft Per Min.
A	Immaterial	24000	66	3420	1050
B	"	21000	63	3100	975
C	"	18000	59	2720	950
D	"	15000	55	2370	915
E & F	"	9000	45	1580	820
G & J	"	6000	38	1130	760
H	"	3000	29	660	650
L	"	4500	34	910	710
N	"	3000	29	660	650
K-M-O-Q	"	1500	22	380	570

All outlets 22 in. in diameter.

UNITED STATES RADIATOR COMPANY'S ONE-COLUMN FLORENTINE RADIATORS FOR STEAM AND WATER.

Number of Sections	*Length Inches	Heating Surface				
		38 inch Height 3 Square Feet per Section	32 inch Height 2½ Square Feet per Section	26 inch Height 2 Square Feet per Section	22 inch Height 1⅔ Square Feet per Section	20 inch Height 1½ Square Feet per Section
2	5	6	5	4	3⅓	3
3	7½	9	7½	6	5	4½
4	10	12	10	8	6⅔	6
5	12½	15	12½	10	8⅓	7½
6	15	18	15	12	10	9
7	17½	21	17½	14	11⅔	10½
8	20	24	20	16	13⅓	12
9	22½	27	22½	18	15	13½
10	25	30	25	20	16⅔	15
11	27½	33	27½	22	18⅓	16½
12	30	36	30	24	20	18
13	32½	39	32½	26	21⅔	19½
14	35	42	35	28	23⅓	21
15	37½	45	37½	30	25	22½
16	40	48	40	32	26⅔	24
17	42½	51	42½	34	28⅓	25½
18	45	54	45	36	30	27
19	47½	57	47½	38	31⅔	28½
20	50	60	50	40	33⅓	30
21	52½	63	52½	42	35	31½
22	55	66	55	44	36⅔	33
23	57½	69	57½	46	38⅓	34½
24	60	72	60	48	40	36
25	62½	75	62½	50	41⅔	37½



Note—Add 1/2 in. for each bushing to get total length of radiator.
H = Total overall height.
T = C. to C. of tappings.
F = Floor to center of bottom tapping.
W = Width of radiator—4 1/2 in.
LW = Width of radiator legs—5 1/32 in.
S = Width of radiator sections, i. e., C to C of sections—2½ in.

Nominal Height of Radiator In.	Actual Height H In.	Steam Supply and Return F In.	Steam Supply and Return T In.	Water Supply and Return F In.	Water Supply and Return T In.
38	38	4	31 9/16	4 1/2	31 1/16
32	32	4	25 9/16	4 1/2	25 1/16
26	26	4	19 5/8	4 1/2	19 1/8
22	22	4	15 5/8	4 1/2	15 1/8
20	20	4	13 3/4	4 1/2	13 1/4

For high legs F. equals 6 in. and H. is increased 2 in. for steam or 1 1/2 in. for water.
For legless radiators deduct 2 1/2 in. from F. and H.

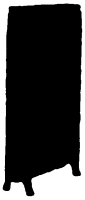
TAPPING DATA

All radiators are tapped 2 in. and bushed as follows:

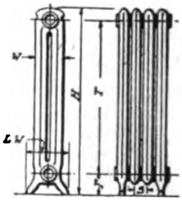
SYSTEM	Size of Radiator Square Feet	Supply In. Diam.	Return In. Diam.
Steam, one-pipe	Up to 24 sq. ft., inc.	1	
	Over 24 up to 60 inc.	1 1/4	
	Over 60 up to 100 inc.	1 1/2	
	Above 100 sq. ft.	2	
Steam, two-pipe	Up to 48 sq. ft. inc.	1	3/4
	Over 48 up to 96	1 1/4	1
	Above 96 sq. ft.	1 1/2	1 1/4
Water	Up to 40 sq. ft. inc.	1	1
	Over 40 up to 72 inc.	1 1/4	1 1/4
	Above 72 sq. ft.	1 1/2	1 1/2

All air valve tappings are 1/8 in.
Vapor tappings as instructed only.
All tappings with R. H. threads unless otherwise ordered.

UNITED STATES RADIATOR COMPANY'S TWO-COLUMN FLORENTINE RADIATORS FOR STEAM AND WATER.



No. of Sections	*Length Inches	Heating Surface					
		45 inch Height 5 Sq. Feet per Sect'n	38 inch Height 4 Sq. Feet per Sect'n	32 inch Height 3⅓ Square Feet per Section	26 inch Height 2⅔ Square Feet per Section	22 inch Height 2¼ Square Feet per Section	20 inch Height 2 Square Feet per Section
2	5	10	8	6⅔	5⅓	4½	4
3	7½	15	12	10	8	6¾	6
4	10	20	16	13⅓	10⅔	9	8
5	12½	25	20	16⅔	13⅓	11¼	10
6	15	30	24	20	16	13½	12
7	17½	35	28	23⅓	18⅔	15¾	14
8	20	40	32	26⅔	21⅓	18	16
9	22½	45	36	30	24	20¼	18
10	25	50	40	33⅓	26⅔	22½	20
11	27½	55	44	36⅔	29⅓	24¾	22
12	30	60	48	40	32	27	24
13	32½	65	52	43⅓	34⅔	29¼	26
14	35	70	56	46⅔	37⅓	31½	28
15	37½	75	60	50	40	33¾	30
16	40	80	64	53⅓	42⅔	36	32
17	42½	85	68	56⅔	45⅓	38¼	34
18	45	90	72	60	48	40½	36
19	47½	95	76	63⅓	50⅔	42¾	38
20	50	100	80	66⅔	53⅓	45	40
21	52½	105	84	70	56	47¼	42
22	55	110	88	73⅓	58⅔	49½	44
23	57½	115	92	76⅔	61⅓	51¾	46
24	60	120	96	80	64	54	48
25	62½	125	100	83⅓	66⅔	56¼	50



Note—Add 1/2 in. for each bushing to get total length of radiator.
H = Total over a'l height.
T = C. to C. of tappings.
F = Floor to center of bottom tapping.
W = Width of radiator—7 1/8 in.
LW = Width of radiator legs—7 13/32 in.
S = Width of radiator sections, i. e., c. to C. of sections—2 1/2 in.

Nominal Height of Radiator In.	Actual Height H In.	Steam Supply and Return F	T	Water Supply and Return F In.	T In.
45	45	4	38 3/8	4 1/2	37 7/8
38	38	4	31 9/16	4 1/2	31 1/16
32	32	4	25 9/16	4 1/2	25 1/16
26	26	4	19 5/8	4 1/2	19 1/8
22	22	4	15 5/8	4 1/2	15 1/8
20	20	4	13 11/16	4 1/2	13 3/16

For high legs F equals 6 in. and H. is increased 2 in. for steam or 1 1/2 in. for water.
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	Over 60 up to 100 inc.	1 1/2	
	Above 100 sq. ft.	2	
Steam, two-pipe	Up to 48 sq. ft. inc.	1	3/4
	Over 48 up to 96 inc.	1 1/4	1
	Above 96 sq. ft.	1 1/2	1 1/4
	Up to 40 sq. ft. inc.	1	1
	Over 40 up to 72 inc.	1 1/4	1 1/4
	Above 72 sq. ft.	1 1/2	1 1/2

All air valve tappings are 1/8 in.
Vapor tappings as instructed only.
All tappings with R. H. Threads unless otherwise ordered.

THE HEATING AND VENTILATING MAGAZINE

Cooperstown, N. Y. October, 1918 1123 Broadway, New York

THE "PHILADELPHIA PLAN" OF COAL ALLOTMENT

How the Heating Trade in Philadelphia Successfully Co-Operated with the Fuel Administration in Developing a Highly-Successful Scheme of Fuel Distribution.

By **JEROME S. CARSON,**
Federal Fuel Administration for Philadelphia.

Editor's Note.—*The plan described in the following article was devised before the coal shortage became so serious as to bring up the question of a possible limiting of the supply. As worked out, the p'an is intended to be permissive, so that it may be adopted by any municipa'ity or section with the approval of the State Fuel Administrator.*

Manufacturers and designers of heating and range apparatus, working in co-operation with the United States Fuel Administration and the Philadelphia Fuel Administration have been so successful in working out a plan for supervised distribution of domestic anthracite coal, and putting it into practical operation, that the scheme has become widely known as "the Philadelphia plan." In Philadelphia, it has not only prevented the wasteful use of coal but has resulted in a great saving. For this reason efforts are now being made to have the scheme nationalized.

Cities in the eastern part of the country are now beginning to adopt it and it is expected that the system will be extended to many cities in the west. It has received the endorsement of the United States Fuel Administration at Washington.

The distribution system was devised as the result of the abnormal conditions brought about during the domestic coal shortage last winter. When consumers learned that there was a lack of coal they besieged their dealers, which resulted in many retailers closing their offices. Riots occurred in some sections of Philadelphia when the crowds were refused admittance to the coal dealers' offices.

Similar conditions were prevalent in other cities at the same time. In Philadelphia, however, City Fuel Administrator Francis A. Lewis decided that quick action was necessary. He showed his business and professional qualities by calling into consultation, Thomas C. Mahady, a Philadelphia fuel and heating engineer, of the United States Radiator Corporation. After every detail of the situation was talked over, Mr. Mahady and Fuel Administrator Lewis decided that those who designed and manufactured heaters and ranges were the proper persons to handle the domestic conservation problems.

Fuel Administrator Lewis then appointed Mr. Mahady his assistant. He was given charge of the work of bringing about a conservation of coal that would afford the necessary relief to the city.

One of Mr. Mahady's first acts was to call a meeting of all designers and manufacturers of heating apparatus. He outlined a plan of conservation, the principles of which are now embodied in most conservation measures. Those who attended the meeting offered their services to the Government without remuneration, and to this day these men are serving without pay.

A number of sessions were held by the heating experts in the Adelphia Hotel, Philadelphia, and it was only a short time before concrete plans were formed. The manufacturers offered and gave the financial assistance that was necessary.

OPENING OF CONSERVATION STATIONS.

Actual work began in December, 1917. "Conservation stations," were opened in every section of the city. In most cases they were established in stores in order to afford easy access from the street and also to provide window displays. The use of these stores was donated by the owners. At first there were about fifteen of them, but this number increased when the original stations became overcrowded. Some of them had such a large attendance it was necessary for policemen to keep the people in line at the door. During the twelve days they were open they had a total attendance of 151,412.

Instructors for the conservation stations were chosen from among the volunteers from the heating manufacturing industry. Three instructors were allotted to each conservation station and they worked in relays. The stations opened during the day and remained open until late at night.

HEATING PROBLEMS EXPLAINED TO THE PUBLIC.

Instruction was based on scientific and practical operation of household heating apparatus. There was no heating problem that was not taken up. To these stations came men and women whose homes contained every possible type of heating and cooking apparatus. They brought their complaints, each of which was gone over thoroughly by the instructors and the people were able to go home and remedy their troubles. Persons from all walks of life took advantage of the opportunity. Presidents

FEDERAL FUEL ADMINISTRATION
AN OPPORTUNITY TO ASSIST UNCLE SAM
CONSERVATION STATION
HELP CONSERVE FUEL.
FEDERAL FUEL ADMINISTRATION

THE WAY INSTRUCTION TALKS WERE GIVEN IN THE "CONSERVATION STATIONS."

of big corporations, United States Government officials, bankers, etc. were among them. Everybody praised the system of instruction.

Colored charts, 5 x 20 ft. were used to illustrate the instructions. They contained standard types of boilers, furnaces, stoves and radiators and their parts. No particular make of apparatus was shown, the illustrations being a combination of all.

The moment the instructors entered the stations they lost their identity as far as their business connections were concerned. They were not permitted to suggest any type or make of heating apparatus. Notices to this effect were posted in all the instruction stations and the visitors were told to refrain from asking such information. One of the reasons for this was that the instruction stations were established for the purpose of conserving coal by correcting the methods of persons who did not know how to operate their heating apparatus efficiently.

The talks given at the instruction stations were on such subjects as "Why Instruction Stations Were Established," "How Coal is Wasted and How this Waste Can Be Stopped," "Best and Most Economical Kind of Fire," "Proper Use of Check and Draft Dampers," "Cleaning of Boilers and Furnaces," "Improper Air Leakage Around Boiler, Furnace or Chimney," "Why Fires Need Fresh Air to Burn Properly," "Conditions in Parts of House Other than Cellar Where Coal is Wasted Due to Loose Windows, etc." and "General Instructions for Care of Steam Boilers, Etc."

In addition to and supplementing these talks instruction cards were handed out, containing simple rules in printed form for operating various types of heaters. The public was asked to hang these cards in a conspicuous place near the boiler or heater in the cellar and see to it that the instructions were carried out.

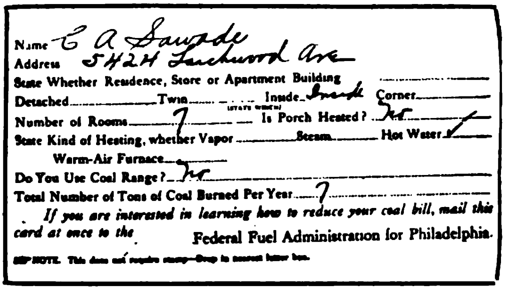
HOW FUEL ALLOTMENTS WERE DECIDED UPON.

In addition to the instruction cards, the consumers also received postal cards which contained a number of questions regarding the size and location of their homes and the type of heating apparatus used. They were told that if they wanted information as to how to reduce their coal consumption they should answer the questions and return the postal cards to the City Fuel Administration. This resulted in 62,196 answers being received from every section of the city and suburbs. The cards gave information concerning homes in almost every city block.

One of the good features of these answers was the fact that each person who replied was interested in cutting down the use of coal. They could, therefore, be classed as the honest consumers who wanted to assist the Fuel Administration in its conservation work. This was the first information of this kind that the Fuel Administration had received and it was indeed important.

All of the cards were turned over to Mr. Mahady. In cases where there was undoubtedly a big waste of coal, men who had acted as instructors at the conservation stations were sent to make an investigation and they advised the consumers as to the cause of their trouble. This resulted in additional important information being obtained.

Then Mr. Mahady called a meeting of his advisory council of heating and range apparatus manufacturers and designers. They went over all the information contained on returned postal



Name C A Sauzde
Address 5424 Larchwood Ave
State Whether Residence, Store or Apartment Building
Detached Twin Inside Inside Corner (state which)
Number of Rooms 7 Is Porch Heated? No
State Kind of Heating, whether Vapor Steam Hot Water ✓
Warm-Air Furnace
Do You Use Coal Range? No
Total Number of Tons of Coal Burned Per Year 7

If you are interested in learning how to reduce your coal bill, mail this card at once to the Federal Fuel Administration for Philadelphia.

NOTE. This does not require stamp—Drop in nearest letter box.

POSTAL CARD FORM TO BE FILLED OUT BY CONSUMERS.

cards and that which had been obtained by the other methods. As the result of this they worked out a standard schedule of tonnage allotment, which has since been applicable to every house in the city, and which has been adopted by other cities which have placed the system of conservation and distribution into effect.

This was done scientifically; first, on a basis of the number of square feet of grate surface installed; second, by actually measuring the cubic contents of standard rooms, the window surface and exposed walls, and third, the number of square feet of heating surface installed.

SUPERVISED DISTRIBUTION SYSTEM.

After the allotment standard was worked out, the problem of putting it into practical operation presented itself. This proved to be almost as big a task as the problems leading up to it. But after working over the subject for some days, a system was devised that fitted perfectly.

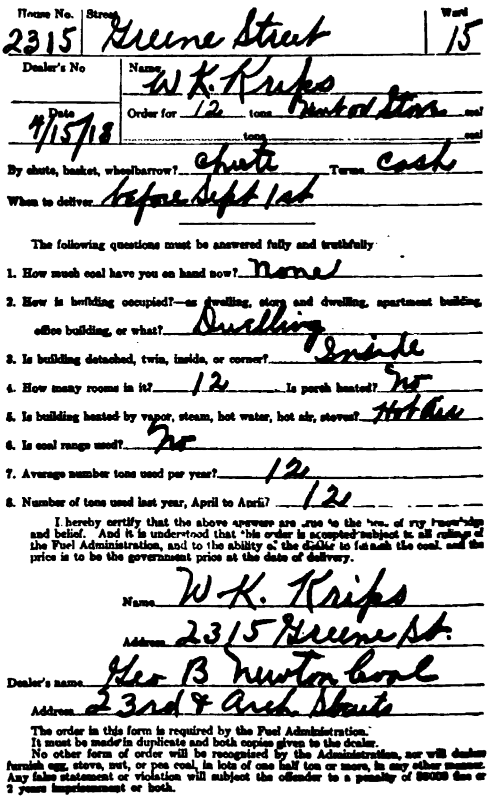
The plan was simple in operation. There were no unnecessary details, as the result of which it is possible to ascertain, without delay, whether or not consumer have ordered more coal than they actually need.

If the war lasts any length of time this system will be extremely simple after the first year. All the facts regarding the coal supply in every house in each city adopting it will be on file and the second year will require very little expert help. In fact, nearly every householder will have recognized the amount of coal he can get and will not attempt to order any more. This will result in a conservation throughout the United States which will be so large that it will be beyond the greatest expectations in the beginning.

The first step is taken by the consumer in obtaining from his dealer two order blanks, which are supplied to the retailers by a bureau of distribution. The bureau of distribution is the headquarters of the distribution system, and in most cases is located in a building near the City Fuel Administration offices.

The forms contain questions regarding amount of coal to be used and the description of the house to be heated. They must be filled out alike, signed by the consumer, and returned to the retailer. One of these the retailer retains for his own file. The other he sends to the bureau of distribution.

The dealer is not allowed to fill the order until three days have elapsed. If, at the end of three days, he has not been advised by the bureau to cancel the order, or to reduce the quantity ordered, he can fill the order complete, if it does not call for over six tons. If more than six tons the dealer is not permitted to deliver more than two-thirds of the amount asked for. When he has a surplus of coal in his yard



House No.	Street	Ward
2315	Greene Street	15

Dealer's No	Name W K Krips
Date 4/15/18	Order for 12 tons Nut & Stove coal tons coal

By chute, basket, wheelbarrow? chute Terms cash

When to deliver before Sept 1st

The following questions must be answered fully and truthfully

1. How much coal have you on hand now? None
2. How is building occupied?—as dwelling, store and dwelling, apartment building, office building, or what? Dwelling
3. Is building detached, twin, inside, or corner? Inside
4. How many rooms in it? 12 Is porch heated? No
5. Is building heated by vapor, steam, hot water, hot air, stoves? Hot Air
6. Is coal range used? No
7. Average number tons used per year? 12
8. Number of tons used last year, April to April? 12

I hereby certify that the above answers are true to the best of my knowledge and belief. And it is understood that this order is accepted subject to all rulings of the Fuel Administration, and to the ability of the dealer to furnish the coal, and the price is to be the government price at the date of delivery.

Name W. K. Krips

Address 2315 Greene St.

Dealer's name Geo B Newton Coal

Address 23rd & Arch Streets

The order in this form is required by the Fuel Administration.
It must be made in duplicate and both copies given to the dealer.
No other form of order will be recognised by the Administration, nor will dealer furnish egg, stove, nut, or pea coal, in lots of one half ton or more, in any other manner.
Any false statement or violation will subject the offender to a penalty of $5000 fine or 2 years imprisonment or both.

TYPICAL COAL ORDER FORM SUPPLIED TO RETAILERS BY BUREAU OF DISTRIBUTION.

and has no unfilled orders, he can begin to deliver the remaining one-third portions of his orders.

This restriction applies particularly to the summer months when the price of coal is lower than during the winter. It gives every consumer a chance to get part of his supply at the lower price and is an incentive to order coal early.

Another good point in connection with the three-day grace period is to give the bureau of distribution a chance to check up on the orders with the standard of allotment, which is the most important part of the work.

CHECKING UP ORDERS.

Dealers mail orders to the bureau every day. Each dealer has a number which must be stamped or written on the orders.

When the orders are received at the bureau, they are checked and then sorted by wards or districts, numbers or names of which must be shown on the order forms. After this sorting they are ready for posting to cards.

When the first order is received from each house in the city, a "master card" is made out for that address and the information on the order transcribed onto the card. The cards are 8 x 5 in. Where there is a sufficient number of houses and buildings in a city to warrant it, the cards are kept in sitting record desks. If there are not a large number of houses in the town, cards can be kept in trays or cases.

In large cities double desks are provided for each 20,000 cards. In some cities it is not advisable to arrange cards by wards, due to the fact that they have irregular boundaries, which necessitates special checking and reference to a map to see whether the proper ward number has been given. After the system has been in use a short time the work can be distributed evenly among the posting clerks by allotting certain sections to each clerk.

Regardless of the guiding arrangement. the cards are filed by streets, then by house numbers. Usually the cards for the even number side of the street are filed together, then the cards follow for the odd numbered side of the same street. The posting clerk sorts the orders by streets, then by odd and even numbers, then numerically. The orders are then posted. The clerk, who must know the distribution system thoroughly, checks each posting to ascertain if the coal ordered, plus coal previously ordered, will exceed the allotment. Answers to the questions are noted and then the order put under one of the several types of buildings to which it belongs.

BUILDINGS DIVIDED INTO THREE TYPES, EACH WITH THREE CLASSIFICATIONS.

There are three types: inside, corner or twin and detached. Also there are three classifications: ordinary dwellings having about six rooms; middle-size dwellings with wide rooms and high ceilings, and large houses such as mansions. In Philadelphia there are 438,000 houses, each of which has been put into one of these classes.

After the orders are classified the allotment standard is applied. It only takes a moment for the experienced clerk to decide how much coal each house is allowed.

Another idea of how the system is worked can be obtained by taking for example, a bona-fide order for fifteen tons of coal. If the tenant had three tons of coal left from last year and his new order called for twelve tons, it would be posted and passed on. If, however, the order showed three tons on hand and called for fifteen more, the dealer would be notified by postal card to hold up the order. The manager of the bureau or one of his assistants would then notify the dealer by letter as to number of tons his customer could have.

If the consumer is not satisfied with his allotment he can appeal the decision to the domestic fuel engineer, who then usually sends out an inspector

UNITED STATES FUEL ADMINISTRATION

FRANCIS A. LEWIS

FEDERAL FUEL ADMINISTRATOR FOR PHILADELPHIA

705 MEDICAL ARTS BUILDING
16TH AND WALNUT STREETS
PHILADELPHIA

QUESTIONNAIRE

Notice: No orders for coal will be approved by the Federal Fuel Administrator if this Questionnaire is not returned with the proper information supplied, within seven days from date.

Not to be answered by consumer.

No.______ Name of firm or individual______
Date sent______ Address______ Ward No.______
Date due______ Zone No.______
Priority Status______ Dealer's No.______ Type of plant______ Inspec. No.______

It is suggested that you obtain the services of a competent heating contractor or engineer to assist you in furnishing accurate information to questions asked, providing you have not a technically trained man in your employ.

SERIES I. GENERAL

(NOTE. Do not check but write in answer to each question.)

1. **Is building store and apartments, church, apartment house, theatre, manufacturing plant, office building, saloon, apartments above saloon, hotel, restaurant, loft building, bank, hospital, school, brewery, green-house, public or private, or what?**______
2. **Is building detached, twin, inside or corner?**______
3. **Do people live and sleep in building?**______
4. **How many people make their homes in building?**______
5. **How long have they been occupants of building?**______
6. **State number of rooms in building that are heated**______
7. **If apartment house, state number of apartments and average number of rooms in each apartment, not including halls**______
8. **State number of porches that are heated**______
9. **Are apartments heated from heating plant which heats other portions of building?**______
10. **Can living apartments be heated without heating other portions of the building?**______
11. **Do you have a sprinkler system in your building?**______
12. **If store or restaurant with living quarters above, state dimensions of store or restaurant**______
13. **State total number of rooms used as living quarters**______

PRIORITY STATUS

1. **Are you considered a public utility?**______
2. **Are you a hospital or charitable institution?**______
3. **Are you working on Government contracts?**______
4. **Specify contract numbers and proper department**______
5. **Are contracts direct with the Government or are they sub-contracts?**______
6. **What percentage of your total production is Government work?**______

7. Is any portion of your building devoted to this work?

8. If so, state what portion and material contracted for

9. Is any part of your building occupied by any branch of the Federal, State or Municipal Government?

10. Is any part of your building occupied by any organization similar to the Red Cross, doing war work?

11. Do you handle perishable food or food necessary for immediate consumption?

12. Describe briefly the nature of your business

13. What size of coal do you believe best adapted to your plant?

14. How much coal had you on hand April 1st?

15. How much coal have you received since April 1st?

16. State your daily coal consumption

17. State your yearly consumption

18. Do you consider your plant efficient?

19. Give your regular coal dealer's name and address

20. How long have you been his customer?

SERIES II. CONSTRUCTION OF BUILDING

1. How many years has your building been erected?

2. State accurately the length, width and height of your building

3. State the number of stories

4. Is building of frame, brick, stone, marble, sandstone, hollow tile, steel sash and glass, sheet iron or corrugated iron?

5. How many walls are exposed?

6. How many North South East West

(By exposed walls is meant outside walls exposed to weather.)

7. Give average size and number of windows in entire building

8. Are windows single or double glass?

9. Are windows weather stripped?

10. If so, in what manner?

11. Do you use metal weatherstripping?

12. State average size and number of doors leading to outside

13. How many skylights in roof?

14. State average size of skylights

15. Are walls of ordinary overlapping clapboards?

16. Are they lathed and plastered inside?

17. If walls are brick, stone or hollow tile, state thickness

18. Are they furred and plastered inside?

19. Are walls plastered outside?

20. If building is of steel sash and glass or reinforced concrete, state architect by whom building was designed

SERIES III. TEMPERATURE

1. Do you use temperature control?

2. If so, what type?

3. What temperature do you maintain in rooms occupied as living quarters?
4. If factory, state what temperature you maintain
5. What facilities have you for obtaining a record of temperature maintained throughout day and night?
6 If any recording instrument is used, so state
7. Do you maintain room thermometers throughout your building?
8. Is building heated in day time only?
9. Is building heated only intermittently?

SERIES IV. CONSTRUCTION OF HEATING PLANT

1. Is your heating plant, steam, hot water, vapor, warm air, or purchased from central plant?
2. How often do you clean heater, flues and pipe?
3. Have they been cleaned since April 1st?
4. Do you sift your ashes?

DIVISION I. STEAM, HOT WATER AND VAPOR

1. Is it a direct or indirect steam system?
2. Note. By indirect system is meant a combined heating and ventilating system using fan to force air through heated coils and thence into rooms through ducts or by means of fresh air intake through heated coils
3. Is boiler and cellar piping covered with asbestos?
4. Do you have trouble on account of bad draft conditions?
5. Is your plant in first-class condition?
6. State name of manufacturer of boiler or boilers
7. How many boilers?
8. State size number of boiler (usually found on front of boiler)
9. State rated capacity of each boiler
10. Is boiler round, square or oblong?
11. State accurately the dimensions or area of grate. (This is important. Don't guess at it. Measure it.)
12. Is boiler equipped with grates capable of burning small sizes of coal?
13. How many square feet of radiation in building (not including piping)
14. Is your heating plant known as a one-pipe, two-pipe system, or a one-pipe system with air line?
15. If vapor or vacuum is used as a heating medium, state name of manufacturer of system installed
16. What pressure is necessary to maintain at boiler in order to heat building?
17. Do you find that some radiators are only heated partially?
18. Do you attempt to adjust air valves to relieve condition?
19. Is it difficult to keep the building comfortable in severe weather?
20. Does it require some time to get building warm in morning?
21. State approximate time
22. Do you urge tenants to turn off radiators when apartment becomes too warm instead of opening windows?

DIVISION II. WARM AIR FURNACES

1. State size number of heater and name of manufacturer
2. State dimensions or area of grate
3. State diameter of smoke pipe
4. Is furnace round or oblong with brick setting?

5. Are pipes and furnace in basement covered with asbestos?
6. State number of pipes leaving heater
7. State diameter of pipes
8. Is a fresh air intake from the outside used?
9. Give its dimensions
10. Is it equipped with a damper which will cut down cold air supply?
11. If fresh air intake is not used, how do you provide air supply?

DIVISION III. TANK HEATERS AND LAUNDRY STOVES

1. State size number and name of manufacturer of tank heater or laundry stove
2. State dimensions or area of grate
3. State capacity in gallons or dimensions of domestic boiler or storage tank
4. State total number of bathrooms in building
5. How many months per year is tank heater used?
6. If you use a laundry dryer in addition to tank heater, state number of families using same
7. Do you have a gas water heater?

DIVISION IV. COAL RANGES

1. State size number and name of manufacturer of coal range
2. State dimensions of fire box
3. Has it more than one fire box?
4. How many ranges do you use?
5. How many months per year do you use range?
6. Is hot water for use throughout the house heated from range?
7. If restaurant, hotel, boarding house or public dining room, state average number of meals (not persons) served daily

(Example: Two meals per day for twelve persons makes a total of 24 meals.)

DIVISION V. COAL STOVES FOR HEATING

1. State number of stoves used
2. Why do you use stoves to heat your building?

I hereby certify that to the best of my knowledge and belief the above questions have been answered truthfully and without intent to furnish misleading information.

I hereby further certify that the amount of coal used last year as stated in Series 1, Div. 1-1, question 17 is correct to the best of my knowledge and belief, being based upon a thorough investigation of coal receipts by me personally.

Signature of owner or properly designated officer of Company.

Your coal allotment will be made on the basis of information herewith furnished. The importance of accurate answers to questions is therefore emphasized. This report will be followed by a rigid inspection of your heating equipment with a verification of answers to above questions. You are urged to put this equipment in proper condition. Coal allotment will be made first to those who consume it most economically. Wasteful, inefficient plants will have their allotments based on the tonnage necessary if plants were in proper condition.

Francis A. Lewis

Federal Fuel Administrator for Philadelphia.

to make an investigation or survey. Upon receipt of the report the domestic fuel engineer decides whether or not the allotment was correct and gives his decision to the bureau of distribution. This is final and binding. Although orders for 2,000,000 tons have been passed upon this year, there have only been 97 appeals.

All orders for commercial buildings, such as factories, theatres, department stores, office buildings, apartments, etc., where domestic sizes of anthracite are used in any quantity, are turned over to the head of the commercial department. Surveys are made in each case and suitable allotments granted. Such investigations often disclose the fact that large buildings have been burning domestic sizes of anthracite when they could have used steam sizes or soft coal. In such cases recommendations are made which not only result in a saving to the consumer but provide more coal for domestic consumption.

VALUABLE STATISTICS OBTAINED.

After the postings are completed the orders can be tabulated to ascertain the number of tons ordered each day, number of tons released for delivery, the amount of coal saved by cutting down excessive orders, number of tons ordered by dealers, classes, amount of each size and period at which the demand by consumers was greatest. At the end of the coal year the Fuel Administrator in each city using the system will know exactly how many tons were used, whether or not there has been an increase or decrease in consumption and he can figure how much he will need in his allotment for the ensuing year. With this information at hand, the big problems in the coal situation during the war will be minimized. But it must be remembered that the distribution system has not been devised only to obtain statistics. Its principal object is to conserve coal by cutting down excessive orders and preventing hoarding.

ORGANIZING INSPECTORS.

Through the adoption of the distribution system it became necessary to have inspectors. The desirable men to carry out this work were those who were familiar with low-pressure heating plants, and who possessed sufficient education to impart their knowledge to others. The logical men were salesmen of heating goods and engineers, because they are usually able to devote some time to the work without it interfering with their regular line of business.

Manufacturers of heating apparatus usually have a sales office in every large city. It was found to be a good plan to have the local Fuel Administrator call a meeting of the branch managers of these concerns, together with representatives of the American Society of Heating and Ventilating Engineers and similar organizations, and outline the work being done and ask for their cooperation.

These men were formed into a Committee on Practical Conservation. The Fuel Administrator appointed a chairman to work with the Administrator and to line up the other members. This chairman appointed a secretary. The city was divided into districts or zones and a manager appointed for each. These men were willing and able to give the work the required time. The zone managers formed the executive committee known as the Conservation Board. A complete list of all men available for conservation work was compiled and each man assigned to a zone manager. In general, the duties of the Conservation Board were fixed as follows:

(1) To act as an advisory engineering board.

(2) To direct the work of the inspectors.

(3) To pass on allotment appeals by commercial consumers.

(4) To determine the coal allotment in difficult cases.

The board decided to meet at stated intervals. A member of the conservation division was placed in charge of the inspection work and appointed as a member of the Conservation Board to act as chairman of the board. After the Conservation Board was completed a general meeting of the Conservation Committee and all inspectors was called to stimulate interest and outline the work of the inspectors. The duties of the inspectors were given as follows:

(1) To make investigations where the stated coal requirements seem excessive and the information at hand is not sufficient to make an allotment.

(2) To report the conditions of heating plants inspected and make recommendations.

(3) To report any violations of the regulations of the United States Fuel Administration.

(4) To investigate all cases of alleged hoarding and get the necessary evidence to make prosecution possible.

The inspectors have become the police department of the Fuel Administration and the guardians of the city's coal pile.

To make the work effective and free from criticism, inspectors were thoroughly impressed that they were not to recommend any specific apparatus to the consumer. When acting as inspectors they lose their identity and only represent the Fuel Administration. All men connected with this work have been sworn into the Government service. A card has been issued to them from Washington which has been their credentials. It enables them to enter any building for the purpose of making an inspection.

Subjects for inspection have been sent to zone managers by the office of the Fuel Administrator. The zone manager sends them to his inspectors through the branch manager or office of the inspector. All inspectors are under the direct supervision of their branch manager. The inspector makes the investigation, fills in the supplemental report and makes his recommendation. The report is then returned to the zone manager, who recommends an allotment and sends all the papers to the office of the Fuel Administrator.

The inspector's personal opinion of the case is valuable, but it is important that he give the basis of his opinion. Where an allotment is to be made to large buildings it is important that the following facts appear in the questionnaire of the inspector's report:

Kind of heat.

Kind of coal.

Name of manufacturer—size number and grate area of each and every coal-burning unit.

Number of months each is used.

Whether or not the heating plant is adequate.

Whether or not the building is poorly constructed or badly exposed.

Whether stated requirements for previous year check with coal receipts.

Tons of coal on hand (41 cu. ft. equal one ton.)

General information in connection with the distribution system is given in the following short paragraphs:

An order, after being given to a retailer, cannot be cancelled and placed with another dealer.

Consumers are urged to purchase from one dealer only. However, they may place orders with more than one dealer, provided the total orders placed do not exceed the consumer's normal requirements.

A copy of every order is filed with the Bureau of Distribution and the house address charged with the number of tons ordered. This eliminates the possibility of a house receiving more coal than it requires by different persons placing orders for the same address.

Coal cannot be removed from one address to another without a permit.

Bribing, or otherwise inducing a driver to deliver coal to an address other than the one given to the driver by the dealer, is a violation and is subject to prosecution.

Coal dealers are not permitted to deliver the final one-third of the consumer's order until all of his customers have received two-thirds of their requirements. But if a dealer has a surplus of one kind of coal, such as egg or pea, and he has no order for that size from persons who have not received their first two-thirds, he is permitted to deliver the final one-third of that amount of coal to customers.

After September 15 coal dealers are not permitted to make "long hauls" outside of a reasonable radius of the yard. Arrangements must be made with a dealer near the consumer, to make the delivery. This is a mutual agreement among dealers.

Dealers are entitled to make a charge for extra labor when the consumer is not home or unprepared to receive the coal when the driver first attempts to make delivery, provided the dealer has given due notice of his intention to make delivery.

Dealers are entitled to charge for carrying in coal. They may also charge for excessive labor, due to local conditions. This charge, however, must be agreed upon between the consumer and the dealer before delivery is made.

Consumers must pay the price prevailing at the time of delivery, regardless of date order was placed.

Prices for the same kind of coal may vary as much as seventy-five cents per ton. The railroad operator must sell his coal to the dealer at seventy-five cents a ton less than the independent operator.

The retail price of coal in Philadelphia is obtained by taking the cost at the mine, fixed by the Government, plus approximately $1.75 per ton freight, plus twenty cents jobber's commission if bought through a jobber, plus the gross margin of $2.50 added by the dealer. This gross margin covers the dealer's overhead expenses, handling, cartage, etc.

To arrive at the average cost per ton to the dealer, the latter takes the total cost of receipts for the previous fifteen-day period, plus cost of stock on hand at the beginning of that period, which gives the total cost for a specified number of tons. This is divided by the number of tons, giving the dealer's average cost per ton. To this is added the gross margin of $2.50, which gives the price per ton to the consumer for the ensuing fifteen-day period. Therefore the dealer gains nothing by delaying delivery. It is to his interest to deliver the coal as quickly as possible.

Private greenhouses are not entitled to coal. Public greenhouses may have 50% of their normal requirements, excepting when their order is for forty tons or under, when they are entitled to the full amount.

Private garages, including those having living quarters, are not entitled to coal. Persons occupying such quarters must be provided for in a house.

Country clubs will not receive any coal after November 1.

All manufacturers have been placed on a preference list and cannot store coal without a permit. They are required to make out a weekly report of coal on hand. The object is to make it possible to give essential industries a reserve stock for emergencies and to keep them running at all times.

Egg and broken coal should be substituted for stove and nut wherever possible. Buckwheat, or a mixture of buckwheat and pea should be substituted for pea coal. Rice and smaller sizes of buckwheat should be substituted for No. 1 buckwheat wherever possible. Such substitution will help the general coal situation.

Most of the foregoing regulations can be carried out through the supervised distribution system because records are kept of every dwelling and building in the city.

LIGHTLESS NIGHTS INAUGURATED.

Again the heating industry came to the assistance of the Fuel Administration when "lightless nights" were put into effect as a measure of further conserving coal. Monday, Tuesday, Wednesday and Thursday nights of each week were designated by the United States Fuel Administration as nights on which certain restrictions must be placed on electric lighting, etc., in every city in the United States.

Because of their familiarity with the regulations, it was decided that the men who had been acting as inspectors and instructors in the conservation work were most suitable for taking over the new duties. Their services were again offered gratis and accepted. A board of eight members was appointed, consisting of four members of the American Society of Heating and Ventilating Engineers and four representatives of manufacturers of low-pressure heating apparatus. These consisted of W. A. Bland, of the American Radiator Co., chairman; E. S. Berry, of the Joseph Spear Stove Heating Company, vice-chairman; Frank C. Hibbs, of H. B. Smith Co.; A. P. Goldsmith, of the E. F. Houghton Co.; C. V. Haynes, of the Haynes Selling Co.; A. C. Mott, Jr., of the Abram Cox Stove Co.; H. D. Kellogg, of the H. B. Smith Co., and William E. Tinker, of the National Radiator Co.

The city was divided into eight zones and each member of the board was placed in charge of a zone. About eighty inspectors were selected from among heating salesmen and engineers and they were divided among the zones. Each zone was also divided into districts and one or more inspectors placed in charge of each district.

In order to do effective work it has been necessary for these men to work at night. They have given up their time in the evenings willingly and the work they have done has been very good. In some cases inspectors have been required to work during the day. In this respect their employers have given them as much time off as necessary.

Instructions issued to the inspectors were as follows:

The inspector will call the attention of all violators to the regulations and report each case with full particulars, direct to the zone manager. The latter will report it to the office of the Fuel Administration and a fine will be imposed where the circumstances justify such procedure.

If a light is necessary for public safety or police protection, the inspector will report the case to the zone manager, who will issue a temporary permit. An official permit will be issued in Philadelphia where conditions warrant, by the City Fuel Administrator. The temporary permit is good for not more than ten days.

Inspectors are cautioned to avoid arguments. Give the violator the facts and if he refuses to turn out the lights and cannot show a proper permit, note the case and report it to the zone manager.

Reports of violations received from sources other than from the inspectors will be sent to the inspectors through the zone manager, on a small card. The inspector will investigate the case, make his report on the card and return it to the zone manager. Similar cards will be supplied to the inspectors upon which to make reports of violations he may find, to the zone manager.

Inspectors will report violations outside of their own district to their own zone manager, but will not warn the violator or take the matter up with him.

Avoid stating that a merchant can have all the lights he wants inside at any time and also outside on Friday, Saturday and Sunday nights. Ask them not to use any more current than necessary at any time. The spirit of the regulations is to save current and thus save coal.

LIGHTLESS NIGHT REGULATIONS

Regulations for the "lightless nights" were issued by the Fuel Administration as follows:

No window or outside display lights any day between sunrise and sunset.

No window or outside display lights Monday, Tuesday, Wednesday and Thursday nights.

No "safety" or "police" lights in any windows, including jewelry stores, on lightless days and nights. A "police" light, if necessary, must be inside of the store, away from the window.

Outside fruit stands, etc., not connected with the store, are permitted only sufficient light to conduct business.

No outside or window lights if there is a store in which to do business.

Zone managers will issue a temporary permit for a "public safety" light, not to exceed 25 watts, if conditions warrant, as in the case of a dark step leading to a store entrance.

Theatres are entitled to sufficient light for safety inside the lobby. No outside lights excepting exit lights.

Carnivals, etc., are permitted sufficient light for safety where no wiring is necessary.

As the result of the inspections hundreds of willful violators have been caught. Some of them have been given their choice of paying $50 to the Red Cross or facing prosecution under the Lever Act, which provides a fine of $5,000. Violations have been reduced to a minimum, however, as the result of the inspectors explaining the regulations to persons who did not understand, and by warning obstinate persons. One warning generally suffices, but when it goes beyond that it is considered a willful violation. The regulations now have been in effect over two months and it is assumed that every person has had time to learn them. All violations in Philadelphia in the future will result in the offenders' turning over contributions to the Red Cross or facing prosecution.

Through their work in assisting the United States Fuel Administration, the heating and range experts have won the distinction of being one of the most patriotic bodies of men in the country. Cognizance of this is taken by the Fuel Administration, which is entrusting to them much important work. It is likely that all of these experts who are available will be called upon again and again in the future to give up more of their time in war work. And from the showing they have made it is certain that they will never be found lacking and that they will keep up their standard of excellence.

In assisting in the conservation of coal these patriotic men are helping the boys in the trenches to push back the Hun horde. Every ton of coal they caused to be saved means more steel for bullets and a smaller casualty list.

STANDARDS OF CENTRAL STATION HOT WATER HEATING SERVICE

Established by the Public Service Commission of Indiana Under Date of August 3, 1918.

Acting on the recommendations of its engineering department the Public Service Commission of Indiana has established a notable set of standards of central station hot water heating, which are promulgated as Order No. 4082. They went into effect August 3, 1918.

The commission's action is the direct result of the fact that central station hot water utilities, in the past, have been billing their consumers on the basis of square feet of radiation required by formulae and not upon the square feet of radiation set. This has led to what was described by the commission as an acute situation due to high and unreasonable billing and a lack of good service.

Incidentally, the investigation conducted by the commission showed that there are very few central station hot water heating plants in the United States outside of the middle west. The United States Bureau of Standards reported that most of the plants are to be found in Ohio, Indiana, Michigan, Wisconsin, Illinois and Minnesota.

The principal items in the new standards are given in the following:

OPERATIONS AND MAINTENANCE.

Boiler horsepower.—There shall be available for use at times of zero weather at least 6 B. H. P. capacity for each 1000 sq. ft. of radiation connected to the utility's mains.

Pressure and Flow of Water in Mains.—(a) Pressure Variation. The pressure of the water supplied by any utility as measured at the consumer's service where it enters the building shall not indicate a differential pressure of less than ½ lb. per square inch working pressure between flow and return pipes and the average pressure in flow and return service pipes shall be sufficient at all times completely to fill all radiators in the consumer's installation.

(b) Pressure Surveys. Each hot water heating utility shall provide itself with the proper gauges and instruments and shall take and record on order of the commission measurements of the water pressures and variations in pressure throughout the system at points indicated on a map of the distribution system on file with the commission.

(c) Flow. The utility shall be equipped and prepared to furnish at least 6 lbs. of water at the consumer's premises per square foot of radiation per hour.

TEMPERATURE PRESSURE AND FLOW OF WATER IN MAINS AND SERVICES.

Under this heading the rules state that each utility shall provide itself with the proper thermometers and other instruments and shall make records on order of the commission of the temperature of the water throughout the system at points indicated on a map of the distribution system on file with the commission.

In new installations the consumer is to pay for the necessary connections for taking the temperature and pressure of the flow and return. This also applies to old installations where there is complaint of inadequate service. The utility itself, however, is to provide the necessary indicating and recording instruments for making the tests.

STATION OPERATING SCHEDULE OF TEMPERATURES.

(a) The standard for heating service shall be determined by the average temperature of the flow and return water in the mains at the heating plant of the utility and shall not be less than that indicated in the following table showing the average temperatures of flow and return.

(b) The average temperature of station flow and return water shall be determined by dividing by two the sum of the temperature of the water in the flow main and the temperature of the water in the return main.

STATION RECORDS.

Each utility shall keep a station record, which record shall show at least the hourly readings of:

The temperature of the water in the flow main.

The temperature of the water in the return main.

The temperature of the outside atmosphere.

TABLE I

Table Showing Average Temperatures of Flow and Return Water.

Outside Temperature, Degrees F.	DAY SHEDULE. 6:00 a. m. to 6:00 p. m.	PERMISSIBLE NIGHT SCHEDULES 6:00 p. m. to 9:30 p. m. 3:30 a. m. to 6:00 a. m.	9:30 p. m. to 3:30 a. m.
70	80	85	70
65	92	98	82
60	102	107	92
55	111	116	101
50	121	126	111
45	129	134	119
40	137	142	128
35	144	148	136
30	151	154	145
25	158	160	154
20	164	165	162
15	170	170	170
10	175	175	175
5	180	180	180
zero	184	184	184
-5	187	187	187
-10	190	190	190
-15	191	191	191
-20	192	192	192

NOTE.—See appendix for schedule of station flow temperature.

TABLE II

Table Showing Temperature-Lowering Coefficients of Wind Movements.

Outside Temperature, Deg. F.	Temperature-Lowering Effect per Mile per Hour, Deg. F.
50 to 40	0.75
40 to 30	1.00
30 to 20	1.10
20 to 10	1.20
10 to 0	1.30
0 to -10	1.40
-10 to -20	1.50

TABLE III

Table Showing Temperature-Lowering Effect of Wind.

	Wind		
Outside Temperature, Deg. F.	Light. 5 to 10 m. p. h.	Medium. 10 to 15 m. p. h.	Strong. 15 to 20 m. p. h.
50 to 40	6°	9°	13°
40 to 30	8	13	17
30 to 20	8	14	19
20 to 10	9	15	21
10 to 0	10	16	23
0 to -10	10	17	25
-10 to -20	11	19	26

NOTE.—The plant operator will vary these wind coefficients to suit local conditions.

The pressure of the water in the flow main.

The pressure of the water in the return main.

The wind velocity where there is installed a suitable wind gauge.

Also, the pounds of coal burned per month where it is not practicable to get daily reports.

The time of starting and shutting down boilers, heating equipment and pumps.

And such other data as is required to determine the characteristics of the load.

SEDIMENT IN MAINS.

Each utility shall provide blow-out pipes, on all lateral extensions of mains and at other necessary places in the distribution system for the removal of sediment in the mains. The mains shall be maintained free of sediment.

Information for Consumers.

Billing of Consumers for Service.—Bills rendered to consumers, it is stipulated shall show the number of square feet of radiation set, all flat rate charges, and the price per unit of service. On bills computed on any other basis the other factors shall be clearly stated.

The billing for all consumers having new heating installations or altered heating installations, shall be based upon the radiation set.

Bills rendered to old customers or to consumers whose radiation has not been altered shall be based upon the radiation set when the amount of radiation set is the correct amount as determined by inspection or test made by the utility subject to the approval of the commission.

The total square feet of radiation set in any consumer's installation shall include in addition to the cast-iron radiators, all exposed piping, indirect radiation and such other radiating surfaces which are not covered by suitable pipe covering.

The consumer shall install storm sash strips or other equally effective protections to the doors and windows and keep them securely fastened in place and maintained so during the heating season.

The company shall at all times exercise reasonable diligence in supplying water in sufficient amount and of such a temperature, as will reasonably heat the premises of the consumer, with all windows and other openings properly closed and maintained.

The company shall furnish hot water in a sufficient quantity to heat the building to a temperature of not less than 70° F., when the outside temperature is 0° F., and above provided that sufficient radiation be installed by the consumer to maintain the desired temperature.

(h) The consumer shall not in any manner change, divert or use the water circulating through said interior system, and shall exercise at all times reasonable care for the protection of the utility's property on the premises and shall not install any additional radiation in said premises without the written consent of the utility.

Indirect Radiation.—Indirect radiation is not recommended but when installed shall be charged for at a rate, 100% in excess of the rate for direct radiation.

UNDERSET RADIATION.

Consumers having less than the proper amount of radiation installed shall be billed at the following increased rate until such time as they can procure and install the proper amount of radiation. Rates for direct radiation, where less than normal or standard amount of radiation is installed:

90% of normal or standard radiation installed, add 5% to normal rate.

80% of normal or standard radiation installed, add 10% to normal rate.

70% of normal or standard radiation installed, add 15% to normal rate.

60% of normal or standard radiation installed, add 20% to normal rate.

50% of normal or standard radiation installed, add 25% to normal rate.

NOTE.—By normal or standard amount of radiation is meant the radiator area required to keep the room or building at 70° F. inside when the outside temperature is zero in calm weather.

Test on Request of Consumer to Utility.—In case of complaint by a consumer, the utility is to immediately investigate the heating consumer's heating system and remedy the difficulty, unless the utility is not at fault when it shall recommend to the consumer in writing what changes should be made to give the desired service.

Evidence of the adequacy of service shall be that, with all radiator valves open and radiators free from sediment, the average temperature of the flow and return water, measured at or near the point of entrance of the service pipes to the building, shall not be less than the day schedule of temperature given in the table of average temperatures of flow and return.

Evidence of the adequacy of the number of square feet of radiation set shall be that, with all the radiator valves open and radiators free from sediment, and the average temperature of the flow and return water maintained as given in table of average temperatures for the day schedule, making allowance for temperature-lowering effects of wind velocity, and with the outside openings, such as doors and windows, etc., properly closed and maintained so as to exclude the outside air in cold weather, and the utility furnishing at least 6 lbs. of water per square foot of radiation, and with pressure differential between flow and return pipe maintained to at least ½ lb. per square inch working pressure and the inside building temperature maintained at 70° F., then and in that case the number of square feet of radiation shall be considered as adequate.

Where a test of a consumer's installation is made by the commission upon formal application of any consumer, if the utility is at fault the expense of the investigation shall be borne by the utility and vice versa.

Regulation of Consumer's Service.—Each utility may regulate the water on the consumer's installation by thermostatic regulator, differential valve, or other device to be maintained at its own expense. The utility is to clean out the consumer's installation at reasonable intervals.

Payment for heating service.—All hot water heating service shall be furnished on a season basis and bills shall be payable monthly from October 1 to April 1, inclusive. The per cent of the total heating bill that shall be due per month for service shall be determined by the utility, subject to the approval of the commission and included as part of the contract with the consumer.

The following payments for heating service are recommended:

October 1st	10%
November 1st	15%
December 1st	15%
January 1st	20%
February 1st	20%
March 1st	10%
April 1st	10%

A consumer receiving service as per his request for a period less than the full heating season shall be charged one-half of the regular rate for that portion of the heating season in which service is not taken and at the full rate for that part of the season in which service is taken.

HEATING SEASON.

Each utility shall contract to maintain regular heating service from October 1 to April 30, whenever the outside temperature is at a point below 60° F., and at such other times after September 14 and before May 21 when the outside temperature is 60° F., or below.

Radiation Requirements.

Temperature in Consumer's Premises.—Each utility shall contract to deliver hot water in sufficient quantites to maintain in the consumer's premises the agreed upon temperature when the outside temperature is 0° F., provided, however, that doors, windows and ventilators are closed and tight and the premises are in evidence of good repair and that there is sufficient radiation set.

ESTIMATING RADIATION REQUIRED

As a tentative basis for the billing of contemplated new consumers and of such other consumers where there is complaint of inadequate service indicating insufficient radition, each utility shall measure the buildings and premises of said consumers for radiation required by the formula and as set out in the table showing temperature-lowering coefficients of wind movements.

Upon the request of any consumer, or the commission, the utility shall furnish a complete detailed set of figures and data relating to the radiation requirements, in said consumer's premises, upon which it is proposed that the consumer is to be billed for heating service.

The utility supplying hot water heating service shall not be required to contract with any consumer to heat only a part of the used portion of a building, residence, or apartment where such other parts of the building or buildings are not provided with adequate radiation suitably connected.

TABLE SHOWING FORMULA FOR ESTIMATING RADIATION.

$$R = C \times Fc + (E - W - D) \times Fe + (W \times Fw) + (D \times Fd)$$

Where: R=Required radiation in square feet.
C=Cubic feet of contents.
E=Square feet of exposed walls.
W=Square feet of windows.
D=Square feet of doors.
Fc=Factor for cubic contents as shown in table.
Fe=Factor for exposed walls, ceiling or floors as shown in table.
Fw=Factor for windows as shown in table.
Fd=Factor for doors as shown in table.

TABLE OF FACTORS

KIND OF EXPOSURE.	Difference in Temperature Between Room and Outside.				
Fw	60°	65°	70°	75°	80°
Single glass	0.478	0.517	0.557	0.595	0.705
Double or plate glass	.212	.229	.247	.265	.282
Single sky light	.382	.413	.445	.477	.508
Double sky light	.212	.229	.247	.265	.282
Fd					
Good door, one-half glass	.244	.265	.285	.305	.325
Good door, solid	.170	.184	.198	.212	.226
Fe					
Frame wall (N-W exposure)	.148	.160	.173	.185	.198
Frame wall (S-E exposure)	.134	.146	.159	.171	.184
12-in. masonry wall (N-W exposure)	.106	.115	.124	.132	.141
12-in. masonry wall (S-E exposure)	.093	.102	.111	.119	.128
17-in. masonry wall (N-W exposure)	.085	.092	.099	.106	.113
17-in. masonry wall (S-E exposure)	.071	.178	.085	.092	.099
Ceiling with no heat in space above	.106	.115	.124	.132	.141
Floor with no heat in space below	.053	.057	.062	.067	.071
Partition wall (frame plastered) but no heat on other side	.071	.077	.082	.088	.094
CUBIC CONTENTS.					
Fc					
½ change of air per hour—Garages, etc.	.0032	.0035	.0038	.0040	.0043
1 change of air per hour—Dwellings, Offices, etc.	.0064	.0069	.0075	.0080	.0086
2 changes of air per hour—Public assembly rooms	.0128	.0139	.0150	.0160	.0172

Appendix.

TABLE A. STATION FLOW TEMPERATURES

Outside Temperature, Degree F.	DAY SCHEDULE, 6:00 a.m. to 6:00 p.m.	PERMISSIBLE NIGHT SCHEDULES	
		6:00 p.m. to 9:30 p.m. 3:30 a.m. to 6:00 a.m.	9:30 p.m. to 3:30 a.m.
70	85	90	75
65	97	103	87
60	109	115	99
55	120	125	110
50	130	135	120
45	139	144	129
40	148	152	139
35	156	160	148
30	164	167	158
25	171	174	167
20	178	179	176
15	185	185	185
10	190	190	190
5	195	195	195
zero	200	200	200
-5	203	203	203
-10	206	206	206
-15	208	208	208
-20	210	210	210

NOTE.—In case of difficulty in maintaining the average temperatures with these flow temperatures, increase the rate of pumpage.

NEW HEAT TRANSMISSION TABLES

A Remarkable Compilation of Factors as Given by Leading Authorities Covering Latest Types of Construction.

By WILLIAM R. JONES,
Superintendent, Department of Buildings and Grounds, University of Pennsylvania.

EDITOR'S NOTE.—*We feel fortunate in being able to present to our readers, commencing in this issue, a series of tables of heat transmission coefficients which are probably the most complete and the most usefully arranged that have made their appearance. No less than 43 tables are included in the complete series, several of which will appear in each issue.*

INDEX OF AUTHORITIES QUOTED.

A—Average of various authorities to be used by the Department of Buildings and Grounds, University of Pennsylvania.

B—Alfred R. Wolff—Translation of requirements of the German Government—*Journal of the Franklin Institute,* Vol. 138, July, 1894, p. 45. Also Transactions American Society Heating and Ventilating Engineers—Vol. 3, 1897, p. 21.

C—Recknagel and Rietschel—Values interpolated by Kinealy. See "Formulas and Tables for Heating," 1899, p. 35. See also THE HEATING AND VENTILATING MAGAZINE, July 1915, p. 21.

D—J. H. Kinealy—Construction used in this country but not in Germany. "Formulas and Tables for Heating," 1899, p. 35.

E—R. C. Carpenter—Translation from Péclet, "Heating and Ventilation of Buildings" —5th Edition, 1911.

F—B. F. Sturtevant Co.—Based on Wolff's figures. Catalogues No. 84 and No. 215 "Heating and Ventilation." (Slight variation from Wolff's figures.)

G—Austrian Government—Translated by W. W. Macon. Trans. A. S. H. & V. E., Vol. 14, 1908, p. 37. Also THE HEATING AND VENTILATING MAGAZINE, February, 1908 and July 1915.

H—N. S. Thompson—"Mechanical Equipment of Federal Buildings," 1915.
  H-a—Federal Buildings, based upon figures of Prof. Homer Woodbridge.
  H-b—Factories or other buildings of inferior construction.

I—A. M. Greene, Jr.—"The Elements of Heating and Ventilation," 1913.

J—Buffalo Forge Co.—"Fan Engineering," 1914. Also catalogue No. 197, 1908.

K—Wm. G. Snow—"The Principles of Heating," 1912. Calculated from data published by Kinealy in "German Formulas and Tables for Heating and Ventilating Work." (Given for a 70° F. difference and when reduced to 1° F. difference do not check with other authorities.

L—C. L. Hubbard—"Power—Heating and Ventilation," Vol. 2, 1914. Values given are for most thorough construction.
For ordinary well-built house add 10%
For fairly good construction add 20%
for poor construction 30%

M—J. M. Harrison—"Applied Heating and Ventilation," 1911.

N—J. R. Allen—"Notes on Heating and Ventilating," 1905. These values are based on those of the German Government.

O—James D. Hoffman—"Handbook for Heating and Ventilating Engineers," 1913.

P.—Louis A. Harding—"Mechanical Equipment of Buildings," Vol. 1, 1916, "Heating and Ventilation," p. 59. Also "Design of Blower heating Systems for Factory and Shop Buildings," 1915. "Heat Losses by Transmission Through Various Building Materials," Trans. A. S. H. & V. E., Vol. 19, 1913, P. 209.

Q—Carlton F. Tweed—THE HEATING AND VENTILATING MAGAZINE, July, 1915. Also Power Plant Library.

R—National District Heating Association—Compiled by Prof. C. B. Veal, Bulletin Jan. 15, 1916.

S—Practical Engineer.

T—American Radiator Co.—*Ideal Fitter,* May 1916, p. 268.

U—Frank L. Busey—Transmission of Heat Through Building Materials. *Power,* April 21, 1914, p. 574.

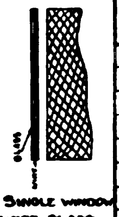
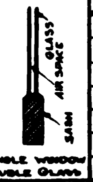
V—Prussian Government—required by. Translation by Kinealy of Recknagel's "Kalender für Gesundheit—Teckniker" for 1897. "Tables and Formulas for Heating."

W—THE HEATING AND VENTILATING MAGAZINE—"Standard Heating Data," February and March, 1917.

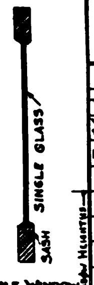
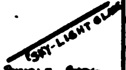
X—James A. Donnelly—"The Establishment of Standard Methods of Proportioning Direct Radiation and Standard Sizes of Steam and Return Mains." Trans. A. S. H. & V. E., Vol. 21, p. 529.

Y—Charles F. Hauss—Antwerp, Belgium. To figure heating work accurately. Constants obtained from practice of German engineer, Adolph Block, of Hamburg. Trans. A. S. H. & V. E., Vol. 10, 1904, p. 114.

Z—E. N. Irwin—"Elements of Heating"—*Power,* Jan. 20, 1914, p. 89.

GLASS	THICKNESS	A USED AT U. OF PA.	C RECKNAGEL & REITSCHEL	G AUSTRIAN GOV. (MACON)	IRWIN	I THOMPSON	K SNOW	Q TWEED	R NAT. DIST. HEAT. ASSO.	T AMERICAN RAD. CO.	I GREENE 1915	W H.&V. MAGAZINE 1917						
 SINGLE WINDOW WIRE GLASS		1.09		1.04	1.0			1.35										
 SINGLE WINDOW DOUBLE GLASS			CC				KK					WW						
		.62	.62				.614					.62						
SINGLE MONITOR GLASS						HHH			RRR	TTT								
	STD.	1.30				1.40 1.35			1.10	.950								
WINDOW GLASS WET											IIII							
		1.10									1.1 1/8" THICK							

HHH Federal Bldg
HHH-Factory
* Opening in brick work measured as total glass surface.
RRR Vol. No. 2 Jan. 15, 1916

GLASS	THICKNESS	A USED BY U. OF PA.	B GERMAN GOV. (A.R. WOLFF)	C RECKNAGEL & REITSCHEL	E PECLET (CARPENTER)	F B.F. STURTEVANT CATS 84 & 215	G AUSTRIAN GOV. (MACON)	Y HAUSS GER. PRACTIC	P HARDING	H THOMPSON a FEDERAL BLDGS.	H THOMPSON b FACTORY BLDGS.	I GREENE 1913	J BUFFALO FORGE CO.	K SNOW	L HUBBARD	M HARRISON	N ALLEN	O HOFFMAN	Q TWEED	R NAT. DIST. HEAT. ASSO.	S PRACTICAL ENG.	T AMERICAN RAD. CO		V PRUSSIAN GOV. (RECKNAGEL)	W H&V MAGAZINE 1917—	X DONNELLY	Z IRWIN	
 SINGLE GLASS, SASH, SINGLE WINDOW	STD.	1.09	.776	1.09		1.215	1.08	1.00	1.126	1.00	1.20	.96	1.09	1.10	1.20	1.25	.776	1.0	1.05		1.2	1.09		1.03	1.00	1.00	1.10	
	TIGHT	1.07	ABOVE CONSTANT TAKEN FROM WOLFF'S ORIGINAL ARTICLE. LATER REPRINTS GIVE IT AS 1.09				1.07 1/10" THICKNESS OF GLASS					1/8 INCH								1.07								
	WEATHER STRIPPED	.90										THICK								.90								
	MEDIUM	1.20																		1.20								
	LOOSE	1.35																		1.35								
WINDOW HEIGHTS	3'-3"				.380																							
	6'-7"				.945																							
	10'-0"				.930																							
	13'-3"				.920																							
	16'-3"				.910																							
	PLATE	.74																		.74								
SASH, SINGLE GLASS, DOUBLE WINDOW		AA	BB	CC		FF	GG	YY	PP	HHa	HHb	II	JJ	KK	LL	MM	NN	OO	QQ	RR	SS	TT		VV	WW	XX	ZZ	
	STD.	.62	.518	.46		.572	.47	.46	.45	.50	.56	.41	.46	.457	.60	.62	.518	.6	.5	.52	.6	.560		.472	.56	.571	.572	
									TRIPLE SASH			1/8 INCH																
									.281			THICK																
 SKY-LIGHT GLASS, SINGLE SKY-LIGHT GLASS		AAA	BBB	CCC		FFF	GGG	YYY	PPP	HHHa	HHHb	III	JJJ	KKK	LLL	MMM	NNN	OOO	QQQ	RRR	SSS	TTT		VVV	WWW	XXX	ZZZ	
	STD.	1.16	1.118	1.16		1.03	1.14	1.06		1.50	1.50	1.06	1.16	1.157	1.30		1.118	1.1	1.1	1.12	1.2	1.118		1.09	1.16	1.00	1.03	
												1/4" THICK																
SKY-LIGHT GLASS, AIR SPACE, DOUBLE SKY-LIGHT GLASS		AAAA	BBBB	CCCC		FFFF	GGGG	YYYY	PPPP	HHHHa	HHHHb	IIII	JJJJ		LLLL	MMMM	NNNN	OOOO	QQQQ	RRRR	SSSS	TTTT		VVVV	WWWW	XXXX	ZZZZ	
	STD.	.62	.621	.48		.621	.48	.48		.50	.62	.51	.48		.65		.621	.7	.6	.57	.65	.621		.492	048	.571	.621	
												1/4" THICK																

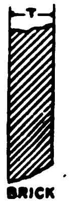
H, HH, HHH, HHHH(a)—Opening in brick work measured as total glass surface.

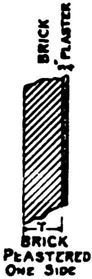
U, UU, UUU — Average of values for various temperature differences.

E — For multiple glass above constants are to be multiplied as follows:

Double by $\frac{2}{3}$
Triple by $\frac{1}{2}$
Quadruple by $\frac{2}{5}$
N layers by $\frac{2}{1+N}$

WALLS





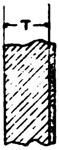
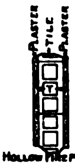
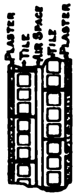
Thickness T	Used by U. of P.	German Gov. A.R. Wolff	Recknagel & Rietschel	Prussian Gov. Recknagel	Peclet Carpenter	B.F. Sturtevant [illegible] (A.R. Wolff)	Austrian Gov. Macon	Hauss Gen. [illegible]	Greene	Buffalo Forge Co.	Snow	Hubbard	Harrison	Allen	Hoffman	Harding	Tweed	Nat. Dist. Heat Asso.	Practical Engineering	American Rad. Co.		Donnelly	H & V Magazine 1917	Thompson 1 Wall Exposed Ha	Thompson 2 Walls Exposed Ha	Thompson Factory Blocks Hb	Irwin	Busey	Spangler				
4"	.60	.680	.520	.492	.430	.658	—	.48	.550	.320	—	—	.660	.680	—	—	.550	.520	.700	.680	—	—	.68	—	—	.680	.654	—					
8"	.42	.460	.370	.348	.370	.458	—	.34	.390	.370	.343	.400	.460	.460	.400	.363	.390	.400	.500	.460	—	.386	.40	—	—	.460	.458	.37					
12"	.32	.320	.290	—	.320	.315	—	—	.310	.290	.300	.320	300	.320	.310	.281	.310	.300	.400	.330	—	.306	.31	.318	.278	.350	.315	.29					
16"	.26	.260	.250	.266	.280	.258	—	.26	.250	.250	.257	.260	.260	.260	.260	—	.250	.250	.300	.270	—	.285	.26	.262	.246	.270	.258	.25					
20"	.23	.230	.220	.226	.250	.228	—	.22	.210	.220	.228	.220	.230	.230	.230	.220	.210	.220	.250	.230	—	.228	.23	.224	.222	.230	.228	.22					
24"	.20	.200	.190	.184	.240	.194	—	.18	.180	.190	.200	.200	.190	—	.210	.174	.180	—	.200	.200	—	—	.20	.200	.180	.200	.194	—					
28"	.18	.174	.160	—	.220	.165	—	—	.160	—	—	.180	—	—	.190	—	.160	—	.150	.180	—	.186	.18	.182	.168	.180	[illegible]	—					
30"	17	—	—	.164	—	—	—	.16	—	—	.171	—	.160	—	—		—	—	—	—	—	—	—	.168	.156	—							
32"	.16	150	.140	—	.210	.143	—	—	.150	—	—	—	—	—	.170		.150	—	—	.160	—		.16	.156	.144	.160							
36"	.14	.129	120	.133	.200	.129	—	.13	—	—	.143	—	.130	—	—		—	—	—	.150	—		.12	.144	.136	.150							
40"	.13	.115	[illegible]	.123	.180	.114	—	.12	—	—	—	—	—	—	—		—	—	—	—	—		—	.134	.124	.130							
46"	11	—		.113	—	—	—	.11	—	—	—	—	—	—	—		—	—	—	—	—			—	—	—							
18"	.25			—	.260			—																									
	AA	BB	CC		EE	FF	GG		II	JJ	KK	LL	MM	NN	OO		QQ	RR	SS	TT		XX	WW	HHa	HHa			UU					
4"	.49	—	.490	—	—	—	—	—	.510	.500	—	—	—	—	—	—	—	.490	—	—	—	—	.70	—	—	—	—	—					
8"	38	—	360	—	—	—	.43	—	.370	.360	—	—	—	—	—	—	—	.380	—	—	—	.500	.42	—	—	—	—	.36	.35				
12"	.29	—	.280	—	—	—	.34	—	.290	.280	—	—	—	—	—	—	—	.290	—	—	—	.342	.33	.306	.267	—	—	.28	.28				
16"	.25	—	240	—	—	—	.29	—	.240	240	—	—	—	—	—	—	—	.240	—	—	—	.257	25	.242	.236	—	—	.24	.24				
20"	.22	—	.210	—	—	—	.24	—	210	.210	—	—	—	—	—	—	—	.210	—	—	—	.214	23	.215	.213	—	—	.21	.23				
24"	.19	—	.180	—	—	—	.21	—	.180	.180	—	—	—	—	—	—	—	—	—	—	—	—	.21	.192	.173	—	—	—	.18				
28"	.17	—	.160	—	—	—	.18	—	.160	—	—	—	—	—	—	—	—	—	—	—	—	.171	.19	.175	.161	—	—	—	.16				
32"	.15	—	140	—	—	—	.16	—	.140	—	—	—	—	—	—	—	—	—	—	—	—	Based on tests by Harding	.17	.150	.138	—	—		.13				
36"	.13	—	120	—	—	—	.14	—	—	—	—	—	—	—	—	—	—	—	—	—	—		.13	.138	.130	—	—						
40"	.13	—	—	—	—	—	.13	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	.129	.119	—	—						
																								—	—								
30"	16																							.161	.150								
																								—	—				.33				

E - See Stone Wall

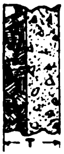
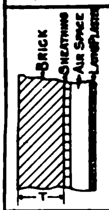
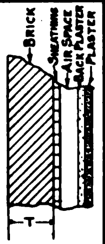
V - Upper figures are equivalent of sizes in metric system

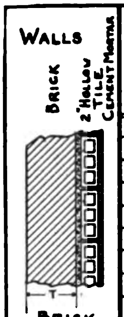
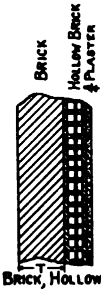
O See Brick Wall, furring, lath and plaster
See Stone Wall

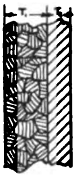
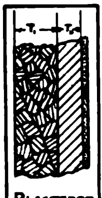
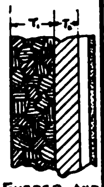
U - Average of values for various temperature differences.

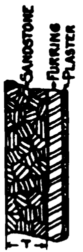
WALLS	THICKNESS T	USED BY U. OF PA. A	GREENE 1913 I	TWEED Q	NAT. DIST. HEAT. ASSO. R	HARDING P	HEATING AND VENTILATING MAGAZINE Wa	Wb	Wc
 MASONRY WITH PLASTER	8"								
	12"	.51	.51						
	16"	.43	.43						
	24"	.37	.37						
	30"	.32	.32						
	36"	.28	.28						
	48"		.23						
 HOLLOW FIREPROOF TILE WITH PLASTER BOTH SIDES			II	QQ	RR	PP	WWa	WWb	WWc
	NOT STATED		.30	30	.30				
	4"	.40				.325	.79	.75	.34
	8"	.31					.56	.54	.27
	12"	.26					.44	.41	.26
	16"	.23					.40	.37	.23
	20"	.20					.33	.31	.20
	2"	.47				.409			
	6"	.36				.281			
 DOUBLE FIREPROOF TILE WITH PLASTER BOTH SIDES, AIR SPACE IN CENTER			III		RRR				
	NOT STATED	.21	.21						

WWa TERRA COTTA OR TILE, PLAIN.
WWb " " , TILE & STUCCO.
WWc " " " " PLASTER.

WALLS	THICKNESS T	USED BY U. OF PA. A	RECKNAGEL & REITSCHEL C	NAT. DIST. HEAT. ASSO. R	H. & V. MAGAZINE W			
 CONCRETE WITH SANDSTONE FACING	12"	.45		—	.45			
	16"	.39		—	.39			
	20"	.35		—	.35			
	24"	.31		—	.31			
	28"	.28	—	—	.28			
	32"	.26	—	—	.26			
			—	—				
			—	—				
		AA		RR				
		.17	—	.17				
			—	—				
			—	—				
			—	—				
			—	—				
			—	—				
			—	—				
 BRICK SHEATHING AIR SPACE BACK PLASTER PLASTER T		AAA		RRR				
		14		.14				

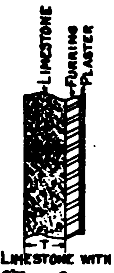
WALLS	THICKNESS T	USED BY U. OF P. A	HARDING P	GREENE (1913) I				
 BRICK. HOLLOW TILE, CEMENT MORTAR	9"	.30	.24					
			2" HOLLOW TILE, 1" CEMENT MORTAR					
 BRICK, HOLLOW-BRICK-FURRING PLASTERED ONE SIDE		AA		II				
	8"	.29		.29				
	12"	.24		.24				
	16"	.20		.20				
	18"							
	20"	.18		.18				
	21"							
	24"	.16		.16				
	27"							
	28"	.14		.14				
	30"							
	32"	.13		13				
	33"							
	36"							
	40"							

WALLS	BRICK, THICKNESS T1	SANDSTONE T2	PLASTERED USED BY U. OF PA. A	RECKNAGEL & REITSCHEL C	THOMPSON Ha	Hb	Hc	H. & V. MAGAZINE 1917 W	
 PLAIN	4"	4"	.41		.324	.31	.270	.31	
	8"	4"	.34	.31	.230	.22	.192	.22	
	12"	4"	.28	.25	.178	.17	.148	.17	
	16"	4"	.23	.22				.21	
	20"	4"	.19	.19				.20	
	24"	4"	.17	.17				.17	
	28"	4"	.15	.15				.16	
 PLASTERED	4"	8"	.35		.303	.29	.252	.29	
	8"	8"	.29	.29	.205	.20	.1.74	.20	
	12"	8"	.24	.23	.167	.16	.139	.16	
	16"	8"	.20	.20				.20	
	20"	8"	.18	.18				.19	
	24"	8"	.16	.16				.18	
	28"	8"	.14	.14				.14	
 FURRED AND PLASTERED	4"	12"	.30		271	.26	.226	.26	
	8"	12"	.25	.26	.198	.19	.165	.19	
	12"	12"	.21	.21	.157	.15	.131	.15	
	16"	12"	.19	.19	PLAIN	PLASTERED	FURRED AND PLASTERED	.19	
	20"	12"	.17	.17				.17	
	24"	12"	.15	.15				.14	
	28"	12"	.13	.13				.13	
BRICK WITH SANDSTONE FACING			PLASTERED	PLASTERED				GIVEN AS BRICK AND SANDSTONE	

Walls	Thickness T	Used by U. of Pa. A	Recknagel & Reitschel C	Peclet (Carpenter) F	Austrian Gov. (Macon) G	Thompson ● Ho	Thompson ▲ Ho	Greene 1913 I	Snow K	Hubbard L	Harrison M	Hoffman Brick + 50% O	Tweed D	Nat. Dist. Heat. Asso. R	American Radiator Co. T	Prussian Gov. Recknagel V	H & V Magazine 1917— X	Hauss Ger. Practice Y	Irwin Z
	12"	.48	.45	32	.58	.54	.52	.54	.443		.45	.465	.28		.440	.451	.50	.45	.45
	16"	.41	.39	.28	.51	.47	.45		.385	.34	.39	.390			.360	.390	.45	.39	.39
	20"	.37	.35	.25	.45	.42	.40	18" .45	.357	29	.35	.345			.307	.348	.40	.35	.35
	24"	.35	.31	.24	.41	.37	.36	.39	.300	.27	.32	.315	23		.263	.318	.36	.32	.32
	28"	.29	.28	.22	.37	.34	.32		.270	.24		.285			.240	.287	.32	.29	
	30"	.28	—	—				.34			.28								Given as solid stone
	32"	.29	.26	.21	.33	.31	.30			.21		.255	.19		.214	.266	28	.26	
SANDSTONE	36"	.26	.24	20	.31	.29	.28	.30	.243	Given as solid stone	.24				.200	.246		.24	
	40"	.25	.22	.18	.29	.26	.25	Given as masonry				Given as solid stone			Brick + 33⅓%	.226		.22	
	44"	.24	.21	.26					.200							.205		.20	
	48"	.23	.19	Given [illegible]	Does not state whether plastered or not. Probably plastered.			.24								.195		.19	
	8"	.60							Given for rubble stone walls, or block masonry			.600							
	12"	.40				.45		.28				.326	.28	.47					
	16"	.34				.39				.272		.273		.41					
	18"	.32						.25					.25						
	20"	.31				.35				.232		.242		.37					
	24"	.28				.31		.23		.216		.221	.23	.33					
	28"	.25				.28				.192		.200		.30					
	30"	.24						.21					.21						
	32"	.23				.26				.168		.179							
SANDSTONE WITH 2" TERRA COTTA OR WOOD FURRING AND PLASTER	35"	.23								80% value for unfurred wall				.28					
	36"	.22				.24		.19					.19	.26					
	40"	.21				.22								.24					
	44"	.20												.20					
	48"	.19						.17					.17						
	8"	.50										.42							

Ho ● Sandstone, Plain = Furred and Plastered Sandstone + 20%

Ho ▲ Sandstone Plastered only = " " " " + 15%.

Walls	Thickness T	Used by U. of Pa. A	Austrian Gov. (Macon) G	Recknagel & Reitschel C	Peclet (Carpenter) F	Prussian Gov. (Recknagel) V	Greene 1913 I	Snow (Sandstone + 10%) K	Hubbard L	Hoffman Brick + 50% O	Nat. Dist. Heat. Asso. R	American Radiator Co. Brick + 33⅓% T	H & V Magazine 1917— X	Thompson ● Ho	Thompson ▲ Ho	Hauss Ger. Practice Y	Irwin Z
	8"	.63								.600							
	12"	.51	.64	.49	32	.496	.54	.487		.465		.440	49	.598	.564	.495	.45
	16"	.43	.56	.43	28	.429		.424	34	.390		.360	46	.516	.495	.429	.39
	18"	.41			.26		.45										
	20"	.39	.50	.38	.25	.383		.383	29	.345		.307	.41	.456	.437	385	35
	24"	.35	.45	.35	.24	.350	.39	.330	.27	.315		.263	.37	.420	.403	.352	.32
	28"	.31	.41	.31	.22	.316		.299	24	.285		.240	.33	.372	357	.319	
LIMESTONE	30"	.30					.34										Given as solid stone
	32"	.29	.36	.28	.21	.293			.21	.255		.214	.29	.336	.322	.286	
	36"	.28	.34	.26	.20	.271	.30	267	Given as solid stone	Given as solid stone		.200		.312	.299	.264	
	40"	.27	.32	.24	.18	.249	Given as masonry							.298	.276	.242	
	44"	.26	Does not state whether plastered or not. Probably plastered.	.23	Given as stone or brick	.225		.220								.220	
	48"	.25		.21		.214	24									.209	
	12"	.43					.28			.326	.52			.49			
	16"	.36							.272	.273	.46			.43			
	18"	.34					.25										
	20"	.32							.232	.242	.41			.38			
	24"	.29					.23		.216	.221	.38			.35			
	28"	.27							.192	.200	.34			.31			
	30"	.25					.21										
	32"	.24							.168	.179	.32			.28			
	36"	.23					.19				.29			.26			
LIMESTONE WITH 2" TERRA COTTA OR WOOD FURRING AND PLASTER	40"	.23					Given as masonry		80% of unfurred limestone		.26			.24			
	44"	.22									.23						
	48"	.21					.17										

Ho ● Limestone, plain = Furred and plastered limestone + 20%

Ho ▲ Limestone, plastered only = " " " " + 15%

CHICAGO COMMISSION ON VENTILATION

A VENTILATION PARADOX

The Use of Air From Chicago's Freight Tunnel as a Refrigerating Agent and Fuel Conserver.

By **THOMAS R. WILSON**
Ventilation Engineer, Chicago Health Department.

Traffic congestion prior to 1901 in the "Loop" district of Chicago was a serious problem for the municipality. This was due in great part to the transportation of coal, freight and the various wastes of our industrial and civic life. The obstruction to street car transportation from slow-moving traffic; the difficulties and delays from fallen horses on icy streets; the inclemencies of the weather, and the other numerous agents incidental to this congestion called for relief.

This traffic need culminated in 1901 in a franchise being granted to the Illinois Tunnel Company to construct and operate a telephone and freight tunnel some 40 ft. below Chicago datum. The tunnel was designed for single track service, the bore being 7 x 6.5 ft. Work was started in 1903 and has continued until at the present time there are approximately 56 miles of tunnel beneath the downtown district and some of the territory outside of the "Loop."

CONSTRUCTION WORK DONE UNDER COMPRESSED AIR.

Many difficulties were encountered during the construction work, due to quick-sand, water, soft ground, etc., and practically all the methods known in soft-ground mining were in operation during the work. Most of the driving was done under compressed air. This, by the way, would have afforded an excellent opportunity for ventilation research work, as in a large number of the headings, which extended from 1 to 2 miles from the air locks, the air was so poor in quality that it would not support a naked flame. The men toiled

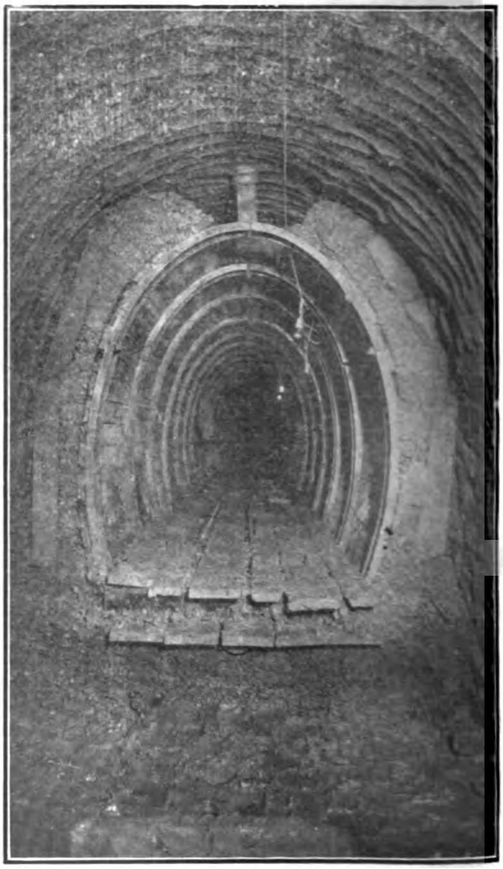


FIG. 1.—CHICAGO FREIGHT TUNNEL UNDER CONSTRUCTION.

eight hours each day in this atmosphere under a pressure ranging from 10 to 24 lbs. per square inch. The air had been breathed and rebreathed by both men and mules. The relative humidity was close to 100% and the temperature averaged about 50° F. The oxygen content was so low that it would not support combustion. Yet in the opinion of the author, who spent over four years on the actual construction work, there was no more sickness among the men than would have occurred among an equal number of employees in a modern up-to-date office building.

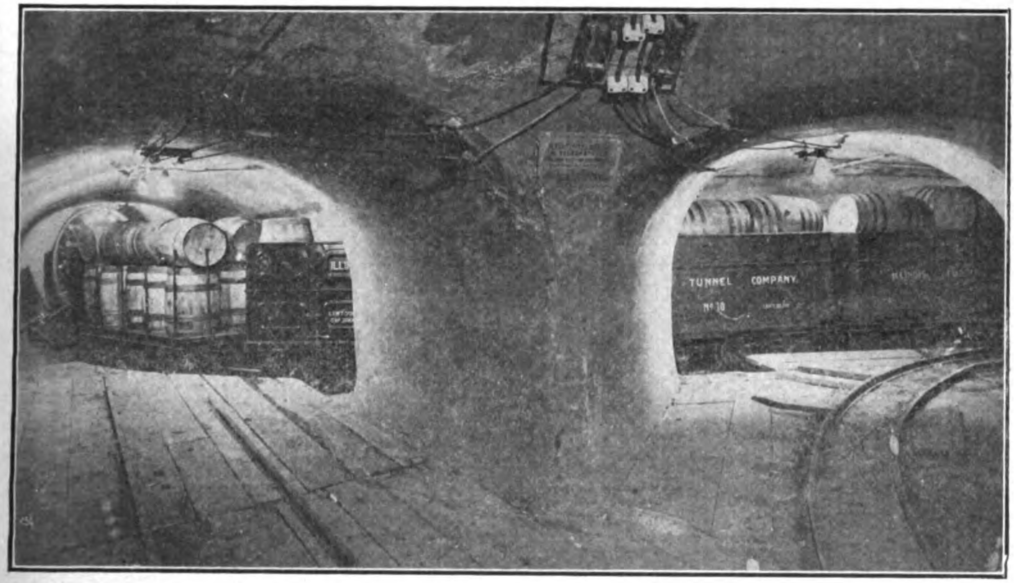


FIG. 2.—LOADED TRAIN AT STREET INTERSECTION, CHICAGO FREIGHT TUNNEL.

At the present time this situation does not exist. Construction work is confined to outlying districts and to minor lateral connections to buildings, the present operations being "open-tunnel" work.

The air locks have been removed and numerous shafts and other entrances substituted. The air changes from these openings and the piston action of the trains, which practically fill the entire bore of the tunnel, are sufficient to adequately ventilate the tunnel, the CO_2 content from actual tests being practically the same as that noted in the outer air. As a protection to life and property water-tight doors have been constructed at suitable points so that they can be closed in case of floods, gas leaks or other accidents, segregating these parts of the tunnel.

ENORMOUS STORAGE OF HEAT BY TUNNEL WALLS.

The enormous quantities of water, clay, hard-pan and other materials, through which the tunnel is driven, act as a great reservoir of heat, extracting heat from the tunnel air when the latter is warmer than the tunnel surface and surrounding materials. Its conductivity is so great that the heat extracted from the air is immediately conducted from the tunnel surface to the cooler materials beyond. The seepage of water back and forth through the various strata also tends to convey heat from the air during the summer months, greatly assisting in maintaining an equal temperature.

During cold weather the opposite flow of heat takes place. The tremendous heat reserve, stored in the materials about the tunnel, is given back to the air through the millions of square feet of tunnel surface.

So accurately do these conditions balance that the entire temperature variation throughout the year in the tunnel air is less than 10°. In the summer months a saturated condition of the air is almost always present, owing to the outside air being cooled to the dew point. This keeps the tunnel air practically free from dust as the condensation of vapor on the walls of the bore makes of the latter a continuous eliminating plate. A further dust removal occurs from the condensation of moisture on the dust particles, thus increasing their weight and causing their precipitation to the tunnel invert.

In the summer of 1916 a complaint was received by the Division of Ventilation of the Chicago Health Department, respecting the use of tunnel air in a cold-meat storage room of a certain down-town hotel. The complainant was convinced that the use of this air must of necessity be unsanitary and he requested, therefore, an investigation by the department. The matter was referred to the writer. The room in question was inspected and all of the known tests for air purity and conditions were made. The following is the laboratory report of the samples taken at the time:

Dust 0
Bacteria 0
colonies on a two-minute plate.
CO_2 .... 3.5
to 3.8 parts per 10,000 parts of air.

The psychrometric readings were as follows:

Temperature—dry-bulb	58° F.
Temperature—wet-bulb	58° F.
Relative Humidity..........	100%

DUST ELIMINATED BY DAMP WALLS.

The entire absence of dust was surprising. This has not been entirely confirmed by later tests which show dust but in very slight quantities. While the report shows absence from odors this is not entirely correct, as there was a slight typical damp tunnel odor, although the latter is not unpleasant and disappears when the air is heated. The report ended with the following statement:

"In my opinion the introduction of tunnel air in this room is a decided asset because of the absence of dust, freedom from bacteria and the cooling effect it has in the room."

Another test of tunnel air used for cooling an engine room in one of the large office buildings was made in Au-

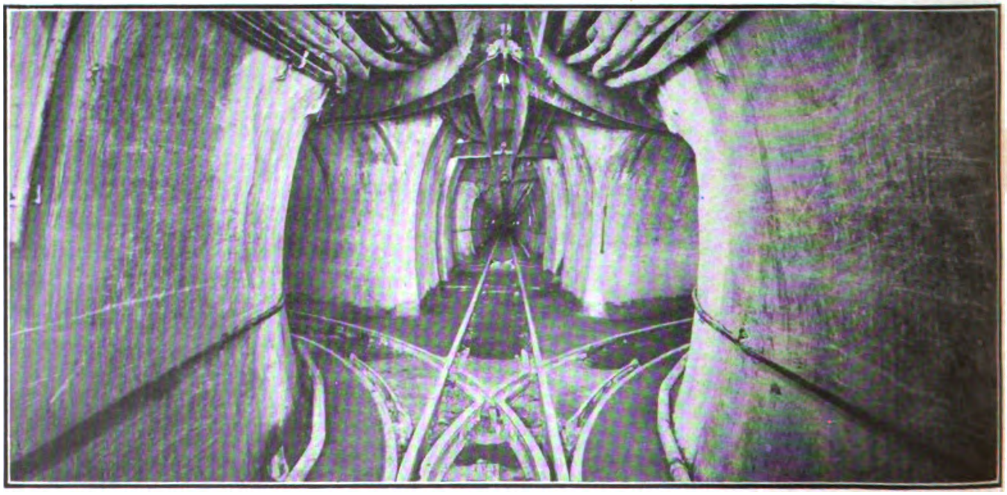


FIG. 3.—STREET INTERSECTION IN FINISHED TUNNEL.

gust, 1916, with an outside temperature of 97° F. The following are the results of this test:

Dust ....Very slight
Bacteria ....None
Odors ....Typical, as noted in previous report.
CO_2 content.................... 4.5 parts per 10,000 parts of air.
Dry-bulb temperature....... 66° F.
Wet-bulb readings were not taken at this test.

The dry-bulb tests noted in the report were taken at the entrance to the tunnel from the boiler-room and the reading is 10° higher than the actual tunnel temperature because of heat radiation from the boilers.

The odor of air from the tunnel was not particularly unpleasant and seemed to disappear entirely after the air had been raised to a temperature of 70° to 80°. It was almost impossible to detect the odors in the engine room or in the theatre or basement restaurant which were tested at a somewhat later date.

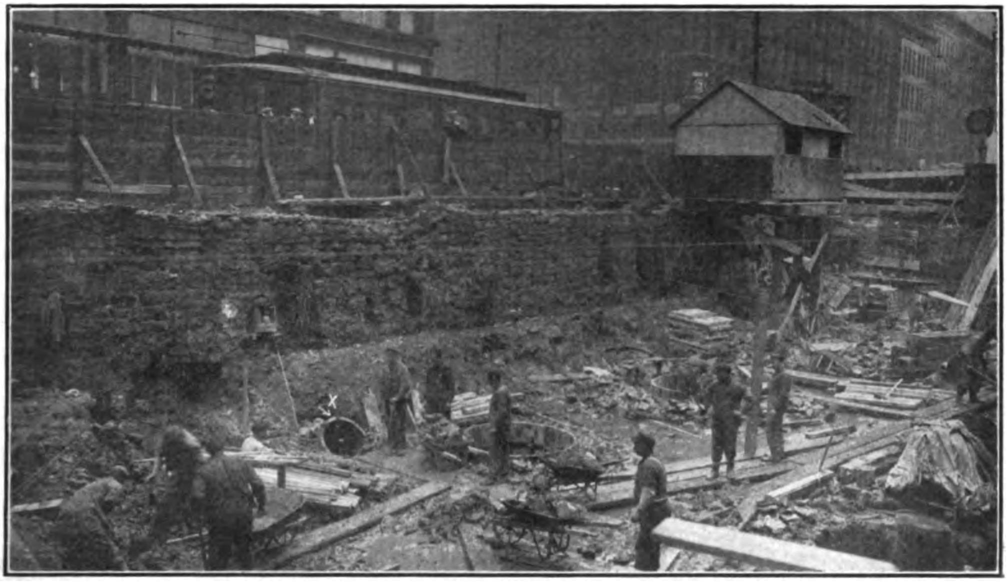


FIG.—4.—EXCAVATION FOR CHICAGO FREIGHT TUNNEL.
Cross Shows Opening Which May Be Utilized for Air Supply.

The cooling effect of the tunnel air so much desired in this boiler room was lost to a great extent, owing to the improper location of the intake and to the method of installing the main supply duct. The intake was placed close to the tunnel eye, resulting in the introduction of a large amount of boiler room air with the air from the tunnel. The supply duct extended uninsulated over the tops of the boilers, where the temperature was 137°.

If the equipment had been properly installed, with the intakes so constructed that they would supply air from the tunnel uncontaminated from air in the boiler room, and the supply duct properly insulated where it passes through the upper portion of the engine room, much better results would have been obtained. As it is, with an outside temperature of 97°, the engine room temperature was only 103°, a very slight increase when we consider the number and size of engines operating in this room.

In next month's issue Mr. Wilson will discuss the use of tunnel air from the Chicago Freight Tunnel for cooling theatres, giving the results of tests in this connection, and the comparative cost to obtain the same results with standard equipment.

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A. S. ARMAGNAC.....................*President*
GUSTAVE PETERSEN....*Secretary and Treasurer*

A. S. ARMAGNAC, Editor
GUSTAVE PETERSEN, Business Manager
HAROLD L. ALT, Contributing Editor

European Representative:
W. G. HOLLINWORTH, 304 High Holborn
London, W. C.

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NOTICE has been served on the New York City Department of Education by the New York City Department of Health which amounts, practically, to an order to show cause why the present practice of ventilating public school buildings by mechanical means should not be abandoned in favor of the open-window method. Thus is resurrected an old-time controversy between the natural and mechanical ventilation advocates, but this time the agitation is more than academic; it has teeth in it. It means, if put through, that hundreds of thousands of school children are to live, during their school terms, under conditions that were familiar enough to those of a generation ago. It means that such an example on the part of a large city like New York could not fail to have a powerful, if not a decisive, influence on the attitude of similar authorities in other cities. Finally, it means one of the most destructive blows to modern ventilating practice that the heating and ventilating trade and profession have ever been called upon to meet.

The immediate developments that have brought about this condition are presented on another page of this issue. Back of these, however, must be mentioned the apathy on the part of the profession in meeting the claims of the open-window advocates with more than negative arguments. This stand has only served to widen the breach that separates the two schools of thought on this subject. What is needed is some basis of bringing the two opposing camps closer together and this, we believe, is being furnished at the present time by the Chicago Commission on Ventilation which has shown that the conditions to be secured are the important thing, rather than the means of securing them.

It is claimed by some that air tests are not within the province of the ventilating engineer, that it is for the physiologist to find the conditions that must be met and that the engineer's work is accomplished when he designs apparatus to meet those conditions. The whole point, however, is whether his apparatus does meet the conditions for which it is designed. It is notoriously true that, as ordinarily operated, it does not. Here is the real problem confronting the heating engineer; how to provide that his carefully-designed scheme in which, we will say, he has fully met the conditions of temperature, humidity, air motion, and the rest of it, is not allowed to be neglected and made worse than useless by improper operation.

We dare say that if the mechanical equipments of school buildings could be operated by their designers we would soon cease to hear the cry that present-day ventilating practice is on the wrong track. In the meantime one might almost wish that the health board would have its way in this matter just to see the reaction that would inevitably follow the adoption of open-window ventilation in a climate like that of New York.

THE MOVEMENT TO ELIMINATE MECHANICAL VENTILATION IN NEW YORK CITY'S PUBLIC SCHOOLS

Radical Action Taken by the New York City Department of Health Based upon Classroom Tests in Twelve School Buildings.

At periodic intervals the exponents of open-window ventilation obtain the front of the stage to proclaim that the present-day method of ventilating buildings by mechanical means is not sufficiently superior to the open-window method to warrant the outlay for the elaborate systems usually installed.

The latest "bombshell" of this sort has been thrown by the New York City Department of Health. In a letter addressed to the New York City Department of Education attention is called to some recent tests of school buildings, some of which were mechanically ventilated and some ventilated only by opening the windows, which apparently show that the prevalence of respiratory diseases is lower when the open-window method is used. The letter concludes with the statement that these tests indicate that it is not necessary for the Department of Education to plan for mechanical ventilating systems in its proposed new school buildings.

While no school construction is contemplated for the present in New York City, plans have been or are being drawn for a number of schools, so that the matter is one that requires an early decision.

In view of the possible consequences of such a step, which would involve the flashing of the word throughout the country and abroad that New York City had abandoned mechanical ventilation for its schools, the action of the New York Health Board is recognized as sufficiently serious to engage the attention of the heating engineers' society, acting, for the time being, through the New York Chapter of the society.

On the call of President P. H. Seward of the New York Chapter a meeting of the chapter's officers and others was held September 13 at the society's headquarters which resulted in the appointment of the following committee "to investigate and report upon proper methods of ventilation of classrooms of schools":

Perry West, chairman; A. S. Armagnac, W. H. Carrier, F. T. Chapman, W. L. Fleisher, R. H. Keith, D. D. Kimball and Arthur Ritter, with H. C. Meyer, Jr. and A. K. Ohmes acting in an advisory capacity.

It was also decided to make the October meeting of the New York Chapter an occasion for discussing this subject in detail.

THE TESTS IN QUESTION.

Due to the importance which has been assigned by the Department of Health to the tests referred to, it will be interesting to recall their principal features. They were made in 1916 by the Bureau of Child Hygiene, Department of Health of New York, in co-operation with the New York State Commission on Ventilation. The commission had full control of the selection of classrooms with reference to the type of ventilation to be included, the preparation of forms for recording observations relating to ventilation, the supervision of methods used in obtaining all data concerning ventilation and the final checking up and analysis of the data on ventilation. The Bureau of Child Hygiene had supervision of all other details of the plan.

The inquiry consisted of two complete studies. The first period lasted from February 19, 1916 to April 8, 1916. The second study began November 4, 1916 and extended to January 27, 1917. In 1916 eight schools were studied and in 1916-1917 twelve schools were selected. For the study of 1916, 2541 children were under observation and for the 1916-1917 study 2992 children were observed. Eighty-six per cent were from eight to eleven years old. The children were grouped in 58 classrooms in 1916 and in 76 classrooms in the study of 1916-1917. They were of the same age in both studies, from the same localities and of the same nationalties, but an entirely different group were studied each time.

THREE TYPES OF VENTILATION USED.

It was decided that three types of ventilation should form the basis of the study:

1. Type A. These were the so-called cold, open-window classrooms, ventilated by natural means. It was the desire to have the temperature kept at 50° F. This, however, was found to be impossible, owing to variations in the weather, and it therefore ranged from 50° to 60° and occasionally higher.

2. Type B. These were moderate-temperature classrooms, kept between 60° and 70° F., averaging about 68° F. Ventilation was wholly by open windows. Some rooms had gravity exhaust ducts while others did not.

Window deflectors were used in only one room in the 1916 study, while in the 1916-1917 study window deflectors were installed and used in all rooms.

3. Type C. These rooms were of the same moderate temperature as in Type B, that is, averaging 68° F. Ventilation of the classrooms was by the plenum fan system installed in the buildings, the windows in these classrooms being kept closed.

Records were made by a corps of nurses at each school session of absences from all causes, absences from sickness other than respiratory, absences due to respiratory sickness, respiratory sickness occurring among pupils in attendance at school, temperature of classrooms at each school session, humidity of classrooms at each school session, and sensations of observers at each school session as to temperature, moisture, odor and air motion in the classroom. The record of air conditions was made at eleven o'clock each morning and each afternoon at the end of the period of study immediately before aerating the room for the recreation period. All data were recorded under the items of odor, temperature, moisture, air motion, and air vents. The temperature was taken with the dry and wet bulb with the sling psychrometer in the center of the room, about 3 to 4 ft. from the floor, and the humidity was computed therefrom by standard methods.

There were 197,977 pupil session units in the 1916 study and 317,881 pupil session units in the study of 1916-1917. The data obtained showed that there were 506 more pupil session absences due to respiratory sickness in Type C (the mechanically-ventilated classrooms at 68°) than in Type B (the open-window classrooms at 68°), and 983 more pupil session absences due to respiratory sickness in Type C than in Type A (the open-window classrooms at 50°). Also, there were 7,257 more pupil sessions of respiratory illness occurring in pupils in attendance at school in Type C (the mechanically-ventilated classrooms at 68°) than in Type A (the open-window classrooms at 50°) and 9,170 more in Type C than in Type B (the open-window classrooms at 68°).

It was also shown by the data that in absences from school of children who are ill with respiratory diseases, Type C (the mechanically-ventilated classrooms at 68°) has the highest percentage in both studies. Types A and B (the open-window classrooms) show variation but in both instances are distinctly lower than in Type C.

The respiratory illness among pupils in attendance at school was found to be higher among the children of the Type A (open-window classrooms at 50°) than in Type B (open-window classrooms at 68°) while both remain lower than in Type C (mechanically-ventilated classrooms at 68°). As an explanation of the excess of respiratory sickness in Type A over Type B, attention is called to the factor of temperature of 50° in Type A and 68° in Type B. In this study the children under observation wore only their ordinary clothing, no extra wraps being provided. Both of these types were open-window classrooms, the essential difference being in the temperature.

Based on these and other data obtained in the investigation the Bureau of Child Hygiene reached the following conclusions:

1. In the closed-window, mechanically-ventilated type of classroom kept at a temperature of about 68° F. the rate of absences from respiratory diseases was 32% higher than in the open-window, naturally-ventilated type of classroom kept at the same temperature (about 68° F.) and about 40% higher than in the open-window, naturally-ventilated type of classroom kept at a temperature of about 50° F.

2. In the closed-window, mechanically-ventilated type of classroom kept at a temperature of about 68° F. the rate of respiratory diseases occurring among pupils in attendance was 98% higher than in the open-window, naturally-ventilated type of classroom kept at the same temperature (about 68° F.) and about 70% higher than in the open-window naturally-ventilated type of classroom, kept at a temperature of about 50°.

3. It was found in this investigation that the relative humidity of classrooms, whether ventilated by natural or mechanical means, was not a causative factor in the occurrence of respiratory illness among school children.

4. It was found in this investigation that the occurrence of respiratory diseases among school children was not influenced by sex.

The tests here described were made the subject of a paper by S. Josephine Baker, M. D., director of the Bureau of Child Hygiene and presented before the Sociological Section of the American Public Health Association at Washington, In October, 1917. The paper has now been reprinted by the New York City Department of Health as No. 68 of its "reprint series."

COMMENTS ON TESTS.

In discussing some of the features of these tests, Perry West calls attention to the fact that classrooms with mechanical ventilation and consequently more or less air motion are compared with those of the same temperature having open-window ventilation and presumably less air motion. "We would naturally expect" he states. "poorer results from the mechanically-ventilated rooms under [illegible] circumstances, even with the same percentage of relative humidity. It is not stated, however, whether or not the same amount of relative humidity was carried, and if no moisture was added in either case, the mechanically-ventilated room would naturally be much drier, due to the more rapid air change and less opportunity to absorb moisture from the pupils.

"In the second place, open windows at 50° F. are compared with a mechanically-ventilated room at 68°, which is, without question, a futile comparison, as either type of room would naturally be more healthful at 50° than at 68°. In neither case is the temperature of the incoming air taken into consideration. This inital temperature has a marked influence on the relative humidity of the air in certain parts of the room, compared with the average humidity of the entire room.

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The Metric System Not Essential in Export Trade.

Basing its conclusions on more than 1400 answers to a questionnaire which was sent to several thousand manufacturing concerns in the United States, some or all of whose products are shipped to countries which are supposed to use the metric system, F. A. Halsey has submitted a report to the American Institute of Weights and Measures which shows that the export trade of the United States is now conducted by the English system and that there is no strong desire or necessity for changing over to the metric system. Mr. Halsey's report constitutes the principal portion of the report of the American Society of Mechanical Engineers' Committee on Weight and Measures.

It is shown, among other things, that 82% of our exporters to metric countries use the metric system not at all in production, while 14% use it partially and in ways that, when explained, are inconsequential; and 0.4% really use it exclusively.

The mechanical engineers' committee also notes that the British Government's Committe on Commercial and Industrial Policy after the war states, among other things, that:

Having given very full consideration to the subject, we are unable to recommend the compulsory adoption of the metric system in this country. In our opinion it is absolutely certain that the anticipated uniformity could not be obtaned for a very long period, if ever. There is, further, the serious objection that if we induced the above-mentioned countries to change over to the metric system, we should be surrendering to Germany the advantage which our manufacturers now enjoy over here, both in their markets and our own.

We are informed that even in France, which has made the metric system nominally compulsory for more than half a century, the "pouce" (or inch) is used in textile manufacture and numerous local measures still survive.

In referring to these considerations, we have to point out that there is no unanimity even as to the theoretical merits of the metric system as compared with our own. The practical argument that its adoption is desirable in order to secure uniformity in the markets of the world has been shown to be unfounded. We are not satisfied by any evidence which has been brought before us that trade has actually been lost to this country owing to the fact that the use of the metric system is not compulsory.

But to attempt to make the use of the system universal and obligatory in this country would cause great loss and confusion at a particularly inopportune moment for the sake of distant and doubtful advantages. We are convinced that, so far from assisting in the reëstablishment of British trade after the war, such a measure would seriously hamper it.

As regards the educational advantages claimed for the change, we have been referred to a statement quoted by the Select Committee of 1895 that no less than one year's school time would be saved if the metric system were taught in the place of that now in use. The information which we have received does not support that statement, and even if it were well founded, it must be remembered that for at least a generation, children would have to learn both the new and the old measures and how to convert from one to the other.

It is often popularly supposed that the introduction of the metric system would render possible the immediate sweeping away of many complicated and varying weights and measures. As we have already indicated, this belief is, in our opinion, wholly fallacious.

We are not convinced that the metric system is, upon the whole, even theoretically superior to the British system, and we are satisfied that the practical objections to the proposed change are such as decisively to outweigh any advantages which are claimed for it.

◆

BUILDING CONSTRUCTION GIVES WAY TO WAR WORK

Important Rulings Showing the Conditions Under Which, for the Present, General Building May Proceed.

The building industry, it has been definitely announced, must make way for the present, at least, for the more urgent war work undertaken by the government. This ruling has been made by Bernard M. Baruch, chairman of the War Industries Board, and the reasons therefor given in a statement submitted by Mr. Baruch, September 21, to the United States Senate in reply to the Senate's recent request for information concerning the authority of the War Industries Board to stop or hold up the construction of private or public buildings.

The resolution of inquiry was passed by the Senate at the suggestion of Senator Calder of New York after the War Industries Board had taken steps to stop the carrying out of New York's $9,000,000 school building programme. Mr. Baruch said in his reply that the authority for the board's action comes from the Priority Shipment Act instructions issued by President Wilson to the board to see that building materials go only to essential industries.

Mr. Baruch then stated:

"Iron and steel are a necessary part of every completed building. They are necessary for plumbing, heating, ventilating, piping, hardware and mechanical equipment. The direct and indirect war needs of this country and of our allies for the last six months of the current year already exceed 21,000,000 tons and the country's total output for the first six months was less than 17,000,000 tons. The unavoidable result is that iron and steel cannot be used for non-war or less essential purposes.

"The United States Fuel Administration, finding that the production of building materials consumed upwards of 30,000,000 tons of fuel per annum, and that there was a shortage in the fuel necessary for our war programme, curtailed very materially the fuel allowed for building materials. The continued production of building materials for non-war and less essential projects would now necessarily be at the expense of productions which our war programme require.

"The railroad administration finds that 25% of the total tonnage moved by the railroads is building material. It is absolutely essential that the portion of this tonnage which represents materials not needed for war or essential purposes should be displaced by tonnage which is.

ACUTE LABOR SHORTAGE.

"The United States Employment Service finds that there is an acute shortage in the labor needed for the war programme. It is absolutely essential that labor which may now be idle, or which may be engaged on non-war or less essential work, should be employed upon work which will contribute toward winning the war.

"It is, therefore, evident that the building and construction field furnishes an instance calling imperatively for the exercise, by the War Industries Board, of the duty, with which the President charged it, of conserving the resources and facilities of the country for war purposes, of determining necessary priorities in production and in delivery, of obtaining access to materials in any way preempted and of anticipatng prospective war needs.

"It is clear that there is not enough iron, steel, transportation facilities, fuel and labor to supply the direct and indirect war needs of the country and the non-war needs also, and that the resources and facilities used in non-war and less essential building projects can only be applied thereby, taking them from the war needs.

"It is not only the policy, it is the clear and simple duty of the War Industries Board to see that the war programme of the country is met, and this programme must be met now, when its needs are upon us. This duty must be fulfilled, even if its fulfilment entails industrial loss in this country, as it does human loss abroad."

The status of the building industry has been uncertain for some time. In the spring it will be recalled the impression got abroad that the government was discouraging building activity on the part of the general public. This impression was corrected by Secretary of the Treasury McAdoo who stated that "the Treasury Department has at no time taken any such attitude, nor has it ever advised banks or mortgage companies against loaning money upon mortgages on real estate."

Following the organization of the National Federation of Building Industries last July close touch has been maintained by the building industry with the government. A notable meeting was held in Washington August 24 when representatives were present of six of the governmental authorities under which the industry is now working. These include the War Industries Board Priorities Committee, War Industries Board (Resources and Conversion Section), the Railroad Administration, the Fuel Administration, U. S. Employment Service of the Department of Labor, and Capital Issues Committee of the Federal Reserve Board. It might be added that the conference was brought about through Chairman Baruch, of the War Industries Board, and President Wheeler, of the Chamber of Commerce of the United States.

One of the first suggestions made by the Federation of Building Industries was that its executive committee act as advisors or specialists to the government, as well as a clearing house for the accumulation of information and of the problems of the industry itself. To the government, it was pointed out, such counsel would be useful in assuring action based upon an understanding of practical conditions, and the industry would be given a greater feeling of confidence that it had been afforded a full hearing. Furthermore, the committee, through such contact, would be able to convey to the industry generally a more vivid perception of necessities for war sacrifice as seen from the government point of view, and communicate them to the industry in its own language and through its accustomed channels.

THREE PRINCIPAL DUTIES FOR BUILDING INDUSTRIES.

Three principal duties under war conditions, it was stated, seem to devolve upon the building industries:

1. Adequate resources in plant, material and service must be made promptly available for war needs and the government's building program speeded with economy.
2. Plant and organization not now devoted to war work must be converted to war work to such extent as may be feasible and desirable.
3. Labor, superintendence, plant and material not now applied to war work when not needed by the government must be maintained if it is to be subsequently available for governmental use, and should be employed in meeting the construction needs of the civil population, maintaining the prosperity in all zones of those who might otherwise be idle and non-productive, particularly in the West, thereby preserving the industry as a national facility.

The central War Service Committee of the National Federation of Building Industries, it was formally announced, speaking with authority for the whole industry, is prepared to undertake this work through its executive board and its sub-committees.

INDUSTRY PREPARED TO MAKE WAR SACRIFICES.

The building industries representatives made it plain that the industry does not seek any means of shirking the duty or slighting the privilege of war sacrifice. The statement was frankly made, however, that great confusion apparently has existed up to the present time in the public mind as to the governmental policy regarding civil construction. This policy, as commonly understood, is that no civil construction should be sanctioned or permitted which will interfere with the national war programme, but that at such time as the wealth-producing business and personal life of a community need civil construction, it should not only be permitted, but sanctioned—subject always to the provision that it must not interfere with the war programme.

If the government intends to be understood as discouraging any civil construction whatever, it can only be due to an official supposition that there is no civil construction which does not interfere with its war programme.

This is the crux of the situation and on this point the committee of the building industries stated among other things:

"Is such a supposition warranted by the facts? It might be true in some sections, but not in others. It might be true at one time and not at another. It is doubtful whether the readjustment of the building industry to the handling of war work would ever—even if the war was continued for several years—result in the complete absorption of all surplus materials suitable for construction needs of the civil population throughout the United States. It is a fact that general conditions, due to the war, both before and since our participation in it, have already curtailed building operations to the irreducible minimum. Further curtailment must imperil the life of the industry.

"There is no question but that steel and some other materials will not be available for building purposes until the war is over. Construction involving steel has been abandoned. This fact is everywhere recognized, and projectors and contractors have stricken steel construction from their program. The government has no need to discourage this class of civil construction, as filling its own requirements has automatically shut off the supply. In like manner, financial, transportation and labor conditions have further shut off the supply.

"However, while these materials will not be available in all probability, until peace returns, other materials exist in surplus. Lumber, for instance, on being cut into ship lengths, leaves an enormous by-product of lengths suitable for building.

"As to fuel, many manufacturing plants use water power, and others use refuse for fuel. In others, adjustments by zoning and consolidating can be effected which will save both fuel and transportation. Substitutes can be devised for materials which have been used in the past, and new sources of material drawn upon which will not only save fuel and transportation, but increase supply.

"Notwithstanding the fact that labor has been taken from building and kindred industries for military and direct war needs, and notwithstanding the fact that war industries are short of labor and that the man-power question is the paramount question confronting us, reports from the Department of Labor, while indicating through a comparison of monthly applications for employment in the various trades, that there is a continued shortage of common labor, mechanics and skilled farm labor, nevertheless indicate that there has been a continued surplus of skilled artisans in the building line throughout the country except in certain congested districts—notably in Atlantic Coast States and certain points on the Pacific Coast.

"This question of labor for building construction for civil purposes might properly be classified as one for consideration at the individual locality, to be taken up as occasion requires. The condition, however, exists that many efficient building artisans are mature in years and well past the age of mental and physical adaptability, and bound to local labor markets by family and property ties and by climatic and physical conditions, who cannot be readily assimilated into those industries so highly essential for war needs.

"Moreover, even if only necessary building is to be carried on, labor must be available for such necessary building as may from time to time and place to place be defined as necessary, and skilled labor to handle such necessary work might well have priority consideration over less essential industries.

"Neither does the transportating of building materials increase the great strain on transportation facilities at the terminal. For the most part building materials never approach terminals or chief junctions, and often such materials can be carried in cars which are returning from a loaded trip." (The development of inland water-ways was also mentioned.)

"Building does not lock up funds, but transfers them from one hand to another. Material from the raw is raised in the form of structure which can be taxed and on which money can be borrowed. It earns its own upkeep and replacement beside the return which the capital would be earning if it were saved. Rent is the first cost of all necessities and civil construction must continue if we would mitigate the increased cost of living.

It is already apparent that the need, especially for dwellings, has in many parts of the country seriously overrun the supply."

TWO CONCRETE PROPOSALS MADE BY INDUSTRY.

The statement of the building industries representatives concluded with two special proposals.

First, that the government through its existing agencies avail itself of the knowledge, experience and ability of the men in the building industries to advise with the proper government agency in each region on all requests for building permits.

Second, that the War Industries Board, the Railway Administration, Fuel Administration, Capital Issues Committee and other governmental agencies which may have occasion from time to time to issue rulings and regulations which may bear directly upon the building industry, call the building industries committee in conference before such rules and regulations are adopted and promulgated. Any necessary curtailment, it is added, will be regarded with much more satisfaction if there exists a clear understanding of just what is needed and why.

RESULTS OF THE CONFERENCE.

In a statement made by President Ernest T. Trigg, of the National Federation of Building Industries, on the results of the conference, he said that the representatives of the federation left the meeting with a feeling of hope that its suggestions will be put into effect in the near future. He said that each of the government representatives present at the meeting discussed frankly and at considerable length the view point of the government, as impressed upon each through his own special activities. Great emphasis was laid by them upon the necessity for the production of enormous quantities of supplies for the military programme and upon the fact that these supplies must be provided now, and not a year of two hence. The question of man power was emphasized as being the most important single consideration in the supply equation, particularly in its bearing upon fuel production.

Later it was announced that an agreement was reached which provided that building materials should be furnished only for war projects, and that all other building projects must have official sanction in the shape of a permit before materials could be supplied to them.

A result of this agreement in New York City, for instance, was that the sale of building materials was suddenly estopped and a large number of building projects, which were partially completed, were held up. Members of the Merchants Association of New York appealed to it for assistance, pointing out that practically all building operations throughout the city had been paralyzed. Protest was immediately made to Washington and the situation was reconsidered there in light of the facts presented. Official permission has since been issued for the continuance of buildings now in course of construction until further notice without permit, but that new construction of all kinds must be authorized by permits issued from the Building Material Section of the War Industries Board after favorable recommendation from the State Council of Defense.

GOVERNMENT'S WAR PROGRAMME CAUSES TRADE EXTENSION COMMITTEE TO LIMIT ITS ACTIVITIES

Elaborate Plans for Carrying on a National Educational Campaign to Await Conclusion of Peace.

As a result of the government's war programme, the Trade Extension Committee, which has been conducting a campaign during the past few months for "new equipment for old buildings," has decided to limit its activities, for the present, to the maintenance of its organization and the preparation of plans for an extensive and continued educational campaign, to be launched on the conclusion of peace with Germany.

This important action was taken at a meeting of the committee in Chicago, September 5, when the question came up whether the organization would proceed with its work and employ a commissioner, to have charge of a bureau to be known as a "Trade Extension Bureau," or to let this project remain in abeyance for the period of the war.

In reporting on the work already conducted by the committee, Chairman William J. Woolley of the finance sub-committee, stated that the planning of the campaign for "building business from old buildings" "has unquestionably brought home the fact that the selling forces of the trade, meaning, of course, the plumbing and heating contractors, are wholly unprepared for such activities. Close study of the question of sales has also revealed the fact that the products represented by this organization are greatly undersold even during normal times."

It is therefore necessary, said Mr. Woolley to properly train the men who naturally come in contact with the ultimate consumer. He urged the establishment of a permanent organization, to be in charge of a competent man, to institute and execute a progressive campaign of education.

He pointed out that when the prominence and importance of this industry is seriously considered, it is hard to realize that we are the only prominent line in this country that does not have a bureau of education and promotion whose function is to devise plans and direct campaigns for increasing the sales of these essential products.

OUTLINE OF ACTIVITIES OF PROPOSED TRADE EXTENSION BUREAU.

Mr. Woolley proceeded to give detailed suggestion for the work of the proposed "Trade Extension Bureau," as follows:

FIRST.—ACCOUNTING FOR THE CONTRACTOR.

A. By compiling a complete bookkeeping system.
B. By compiling a cost system.
C. By compiling short, efficient methods of estimating.
D. The starting and stopping point of credit extension by the contractor.
E. Collections.
    1. Proper contract forms.
    2. Trade acceptance.
    3. Collection forms.
F. Financing a business.

SECOND—PROMOTION

A. How to build personality.
B. How to construct and use a showroom.

C. How to construct and decorate a show window.
D. Salesmanship.
E. Business location.
F. How to prepare and use circular letters literature.
G. How to successfully stage a selling campaign.
H. How to construct and use a follow-up system:
  1. On prospects.
  2. On estimate submitted.
J. How to secure the co-operation of journeymen (selling service).
K. How to secure the co-operation of manufacturers, jobbers and salesmen.
L. Establishing of National Sales weeks.
M. Advertising.
N. How to secure the co-operation of competitors.

THIRD—EDUCATION

A. The distribution of condensed printed pamphlets covering each of the above topics prepared by the commissioner.
B. Changing public prejudice.
C. Substitution and true costs of so-called cheap materials.
D. Interchange of views between manufacturers, jobbers and contractors.
E. Compiling of an official list of plumbing and heating contractors.
F. Lectures by the commissioner at all state and national meetings of the trade and salesmen's meetings.
G. Securing enthusiastic co-operation of local associations.
H. Promotion crews to make experiments and educational sales drives.

Following the reading of Mr. Woolley's report, James N. Conran asked if this movement could be financed. He requested the representatives of the various organizations present to give their views.

J. F. Evans, speaking for the Eastern Supply Association, stated that the work of the Trade Extension Committee was a worthy movement and that it should be continued along practical lines. He recommended, however, that for the present the work be confined to that of an educational character, as it was contrary to the wishes of the Government to create new business. He quoted Judge Parker, saying that materials would be available for needed repairs and the maintenance of present equipment and not replacements or improvements.

J. R. Steneck, president of the Central Supply Association, stated that he felt like Mr. Evans, and thought it was necessary to move cautiously and not do anything which might conflict with the purpose of the administration, namely, "the winning of the war." "This is a time when we must subordinate business and personal action to the winning of the war," said Mr. Steneck. He then gave numerous instances of what other industries have been compelled to do in the way of sacrifices and retrenchments in business, and he was disposed to believe that it would be better to defer the matter, but was in favor of carrying on the work of the Trade Extension Committee in a limited way.

C. V. Kellogg, in discussing the question, stated that there is no doubt we are facing a serious problem, and continuation of the work of the committee would be very important so far as collections were concerned. He was in favor of continuing the work of the committee along educational lines. C. B. Nash advised that it would be necessary to collect the money or let the committee die, and if the move were made the work might never be revived. He felt there should be an intermediate course so that after the war the work could be resumed to the fullest extent.

Mr. Evans then suggested that the Publicity Committee might fix a minimum amount of money to work on to keep the movement alive, and that this proposition could be submitted to the fall meetings of the different associations interested in this movement. Mr. Conran then said that the greatest benefit so far accomplished has been the co-operation between the manufacturer and jobber on one hand and the plumber on the other, and he hoped that this would be continued until after the war and thereafter.

Mr. Woolley said that he was of the belief that if the money could not be raised now, the case would be hopeless. He said: "It will take twelve to eighteen months to get the bureau properly started," and he told of other industries that have done very successful work on educational and 'trade extension' lines. Continuing, he said: "Everyone has admitted the necessity of the reforms as advocated by the committee, and they can only be brought about through an establishment of a central bureau. There is no question that if this move is backed up financially by manufacturers and jobbers, that it will benefit their investment eight thousand times over."

W. M. Webster, representing the National Association of Brass Manufacturers, stated that he believed that this was not the time to extend business in view of the Government's wishes, but thought it worth while to keep going if it could be done for a nominal expense.

Louis Bruch was the next speaker to enter into the discussion. He said that "extension" means carrying on, and that the work of the Trade Extension Committee meant not simply a movement toward immediate but rather a betterment of business methods, the necessity of which have existed for many years. He suggested that the name of the committee be changed to that of the Trade Educational Committee, its purpose being the betterment of business methods.

After luncheon the afternoon meeting was called to order. It was suggested that the recommendations of Mr. Sullivan and Mr. Bruch to confine the committee's work to educational advancement, be presented for consideration at the next regular meeting of the Trade Extension Committee.

Mr. Kellogg moved that the work of the Publicity Committee be approved and that the financing of this movement be referred back to the Finance Committee, and that they take the matter up with the different associations and recommend the raising of a sum of money sufficient to carry on the work of the committee and keep it in existence until a more propitious time. Mr. Kellogg was unable to state exactly how much money was needed, but he was confident that a nominal sum could be raised for carrying out a modified program and that the balance of the work could be formulated to fit the purse.

The following members were present: L. McNamara, president, National Association of Master Plumbers; Paul Blatchford, secretary, Central Supply Association; J. F. Conran, Standard Sanitary Mfg. Co.; C. V. Kellogg, Kellogg-Mackay Co.; B. O. Tilden, American Sanitary Works, Trenton, N. J.; Publicity Committee—William J. Woolley, chairman; C. H. Nash, Standard Sanitary Mfg. Co.; M. R. Ebersole, American Radiator Co.; E. J. Hanley, Educational Committee of the National Association of Master Plumbers; J. T. Sullivan, Thomas Maddock's Sons Co., Trenton, N. J.; Joseph F. Evans, Eastern Supply Association; W. M. Webster, National Association of Brass Manufacturers; J. R. Steneck, president, Central Supply Association; George Mehring, Heating and Piping Contractors National Association; Louis Bruch, American Radiator Co.; Trade Press—O. T. Carson and W. H. Burquest, *Domestic Engineering;* Peter M. Munn, *Plumbers' Trade Journal;* Charles H. Bishop, *Metal Worker, Plumber and Steam Fitter.*

The War and the Heating Engineer

U. S. Standards for Industrial Housing.

Government standards for war housing of permanent construction have been issued and while they are not intended as inflexible requirements, failure to conform to them is not likely to be accepted unless supported by very strong reasons. Local building codes, housing laws and similar ordinances are to be followed except where they permit lower standards than those set forth by the government.

The types of houses covered by the standards include single-family house, two-family house, single-family house with rooms for lodgers or boarders, lodging-houses for men, hotels for men, lodging-houses for women, tenement houses and boarding houses.

One of the general provisions is that no living quarters are to be in the basements. For cooking, gas is preferred, but flue for stove coal is to be provided, all flues to be lined.

An unusual provision is for "roof air space." It is provided that "in every house there shall be a minimum clear air space of 8 in. between the ceiling and the roof, this space to be provided with adequate waterproof openings for ventilation, at both ends if practicable."

Every room is to have at least one window opening directly to the outer air, each room to have a window area of not less than 12 sq. ft. Cross ventilation as direct as possible is to be provided for all rooms through windows, transoms or doors.

Type 1 (single-family house), Type 2 (two-family house, or "two-flatter, one family upstairs, one down) and Type 3 (single-family house with rooms for not more than three lodgers or boarders) are to comply with the following heating requirement: "Provision to be made for heating houses. If not otherwise heated, bathroom to be heated from kitchen stove."

Type 4 (lodging house for men) and Type 5 (hotel for men) are to be heated as follows: "Except where connected with a central plant, provision to be made for independent heating."

Type 6 (lodging house for men) and type 7 (hotel for women) also have the same heating provision, that "except where connected with a central heating plant, provision to be made for independent heating.

Government Housing Plans.

In addition to the $50,000,000 allotted to the Shipping Board for housing purposes, the Department of Labor is well along with its plans for utilizing the $100,000,000 appropriated for similar purposes. In a statement issued by the department it is shown that even with a sum of this magnitude it is manifestly impossible for the Federal Government to assist every community which is embarrassed with a housing shortage. In the following industrial centers developments of varying degrees of magnitude have been projected:

Alliance, O.; Aberdeen, Md.; Bethlehem, Pa.; Bridgeport, Conn.; Bath, Me.; Bettendorf, Iowa; Butler, Pa.; Charleston, W. Va.; Dayton, O.; Davenport, Iowa; Erie, Pa.; East Chicago, Ind.; Elizabeth, N. J.; Florence, Ala.; Gary, Ind.; Hammond, Ind.; Indiana Harbor, Ind.; Indianhead, Md.; Lowell, Mass.; Milton, Pa.; Madison, Wis.; Mare Island, Cal.; Norfolk, Va.; New Brunswick, N. J.; New London, Conn.; Niagara Falls, N. Y.; Niles, Ohio; Newport, R. I.; Portsmouth, N. H.; Puget Sound, Wash.; Philadelphia, Pa.; Quincy, Mass.; Rock Island, Ill.; Seven Pines, Va.; Sheffield, Ala.; Sharon, Pa.; Staten Island, N. Y.; Tullytown, Pa.; Tuscumbia, Ala.; Watertown, Mass.; Watervliet, N. Y.; Warren, Ohio.; Waterbury, Conn.; Woodbury, N. J.

At Bridgeport, Conn., the Bridgeport Housing Company has obtained a Government loan of $3,000,000 to build houses for 608 families in that city. The Cauldwell-Wingate Co., New York, is the contractor. Additional housing plans in Bridgeport will entail an outlay of $2,000,000.

At Quincy, Mass., the industrial Housing Commission is building 21 dormitories, one mess hall and one recreation building for employees of the Fore River works of the Bethlehem Shipbuilding Corporation.

At Harriman, Pa., near Bristol, construction has begun of 200 homes for employees of the Merchant Shipbuilding Corporation.

At Bath. Me., a project is under way for building 125 houses for employees of the Bath Iron Works.

Details of other housing developments planned by the Industrial Housing Department include the following: Newport, R. I., $300,000 housing project, Clarke & Howe, Providence, architects; Philadelphia, 800 new dwellings for workmen on Oregon Avenue, to cost $3,500,000, Rankin, Kellogg & Crane, architects, Philadelphia; Erie, Pa., 1000 two-story homes for workmen, A. H. Spahr, architect, Pittsburgh; Elizabeth, N. J., new homes for workmen to cost $500,000, Charles W. Oakley & Son, architects, Elizabeth; Niagara Falls, new homes for workmen to cost $6,000,000, Dean & Dean, architects, Chicago; New Brunswick, N. J., 500 dwellings for workers in the plant of the Wright-Martin Aircraft Corporation, involving a cost of $1,500,000.

At Swedland, Pa., 61 two-story houses are being built for the Alan Wood, Iron & Steel Co., of Philadelphia, by A. B. & C. F. Millett.

At Gibbstown, N. J., 60 new houses will be built for employees of the E. I. du Pont de Nemours Co., of Wilmington, Del.

At Essington, Pa., the Westinghouse Electric & Mfg. Co., of Pittsburgh, has arranged for the construction of 300 2½-story brick and stucco dwellings for employees at its Essington plant.

Among the appointments made by the Bureau of Industrial Housing and Transportation in connection with projected housing developments, are the following:

Staten Island, N. Y.—Architects, Delano & Aldrich, New York; town planner, A. F. Brinkerhoff, New York; engineer, C. S. Pollock, New York.

Florence, Ala.—Architects, Warren & Knight, Birmingham, Ala.; town planner, Harold A. Caparn, New York; engineer, Julian Kendrick, Birmingham, Ala.

Sheffield, Ala.—Architects, Warren & Knight, Birmingham, Ala.; town planner, Harold A. Caparn, New York; engineer, Julian Kendrick, Birmingham, Ala.

Plans of War Department for Cantonment Extensions.

The following statement has been authorized by the War Department:

Expansions of camps and other changes at training centers have been decided on as follows by the general staff:

Camp Hancock, Ga., is to be a machine gun center and will be enlarged to accommodate between 55,000 and 60,000 men. The officers' training school, now housed in tents at this point, will be provided for in barracks and quarters similar to those already erected at other cantonments. The improvements for this purpose will cost about $2,000,000. This figure does not cover the increased cost for other construction that will be necessary to care for the increased number of men to be located at this camp.

It has been decided to make Camp Grant an infantry replacement camp to accommodate between 55,000 and 60,000 men. The present capacity of this camp is about 42,000. The alterations and additions made necessary by this change will be made after the division now located there is moved.

Field artillery firing centers are to be located at West Point, Ky., Camp Jackson, S. C., and at Fayetteville, N. C. Options on sufficient land for this purpose have been secured at all these places. It is planned to locate six brigades at Fayetteville, six at West Point and four at Jackson.

It has also been decided to erect permanent buildings for the officers' training schools at present housed in tents at Camps Lee, Gordon and Pike. These schools have a capacity of about 6,000 men. The estimated cost of erecting barracks and quarters and doing other construction work at each of these schools is about $2,000,000.

War Savings Societies for Employees.

The Pioneer Division of the National War Savings Committee, representing the New York district, is urging the immediate establishment of war savings societies in every trade. Individual members will be asked to refrain from the purchase of non-essentials, not only in dress, food and fuel, but also in the daily extravagances.

Community Houses Instead of Monuments.

The erection of community houses as fitting memorials to the brave men, living and dead, who are saving the world for Democrack, is suggested editorially in *The American City* for September. "Liberty Buildings" is the name proposed for these structures, which, erected immediately after the war, would perpetuate the democracy of the camp and would serve as neighborhood gathering places for civic activities and fellowship for all the people.

Joseph Harrington, vice-president of the James A. Brady Foundry Co., Chicago, who is well known to members of the National District Heating Association as a contributor to the association's proceedings and discussions, has been appointed administrative engineer of the United States Fuel Administration for Illinois.

The Fourth Loan is the Fighting Loan.

As the campaign for the Fourth Liberty Loan nears its climax the American Army in France moves on toward Berlin. Under our own leaders the great American Army has won a notable victory.

The Fourth Loan must be a great success. The Fourth Liberty Loan is a fighting loan.

When our soldiers on the battle front are braving death, each one offering to make the supreme sacrifice for his country and the great cause, we who remain safely at home surely should give them every support, should make every sacrifice to strengthen them. If we can not fight ourselves we can make our dollars fight.

It is a great cause for which America is engaged in this war; it is a great struggle in which the very hope of the world is bound up that is being waged in Europe and on the high seas. It is an honor to have a part in it and all Americans, all of their lives, will be proud of the part they had in it or ashamed of their failure to do their part.

The Fourth Loan is a fighting loan. Every subscriber to the Loan strikes a blow for Liberty, for Victory.

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Figuring Heat Losses from Compound Walls.

EDITOR HEATING AND VENTILATING MAGAZINE:

Referring to the Standard Data Sheets published each month in your magazine, will you kindly advise me regarding the coefficients in Data Sheet No. 1-D, published in the March, 1917, issue. Are the thicknesses given for the tile and stucco and for tile, stucco and plaster constructions intended as the entire thickness of wall, including stucco and plaster, or thickness of tile only?

Atlanta, Ga. A. F. G.

The figures given in the Data Sheets for tile, brick, etc., refer to the rough wall. To get the total finished thickness, the plaster and stucco must be added to the thickness of the rough wall. A 4-in. tile wall, plastered one side, would probably be from 4¾ in. to 5 in. thick and so forth.

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Current Heating and Ventilating Literature.

Under this heading is published each month an index to the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the articles mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

AIR CONDITIONING

Dry Air and Cold Steam. Frank Richards. 1000 w. Pwr Pt Eng—June 1, 1918. Relation of vapor and air in saturated mixture to temperatures and pressure. 20c.

HEAT INSULATION

Evolution of Heat Insulation. Austen Bolam. 2000 w. Pwr Pt Eng—June 1, 1918. Materials tried, combinations, test results, and present practice. 20c.

HEAT TRANMISSION

Some Recent Studies in Heat Transmission. Arthur J. Wood and Roy B. Fehr, with discussion. Ills. 40 pp. A S R E Jl—March, 1918. Studies aiming to establish constants applicable to practical engineering problems. 40c.

HOT-WATER HEATING

Hot-Water Service. M. W. Ehrlich. Ills. 2200 w. Pwr Pt Eng—June 15, 1918. Method of calculating the required heating surface. 20c.

LEGAL DECISIONS

Recovery Under Contract to Install Heating and Ventilating Plant.

In an action against a city it appeared that in August, 1910, the plaintiff was awarded the contract for heating, by the hot-air system, and ventilating, a schoolhouse in the city. The following September a contract was made with one Morrison for the erection of the building, under which he was to furnish material and labor and do all the work except "heating, plumbing and painting." In November the system of heating was changed from hot air to steam. The plans for the building were filed as required by the Massachusetts statute sometime before, February 4, 1911, and on that day a state inspector of public buildings wrote to the architect in charge, disapproving certain parts of the plans. The inspector's certificate as to filing mentioned in the statute was never issued.

The building of the vent and heat ducts was a part of Morrison's contract. The ducts constructed by him, while apparently suitable for a system of heating by furnace, were not suitable in connection with a steam-heating system. The auditor found that Morrison was requested to build ducts proper for a steam-heating system and refused to do so.

The plaintiff contracted with the Wadsworth English Fleet Company to perform the work required to be done by him, with certain exceptions. All this work was completed in substantial compliance with the agreement, and it was found that the system for heating and ventilating furnished by the plaintiff conformed to all the rules of the district police, that the system was capable of furnishing a uniform heat of the degree called for by the specifications, and that the difficulty in ventilation was due solely to the insufficiency and defective construction of the ducts built by Morrison. There was a finding for the plaintiff and the defendant excepted. The Massachusetts Supreme Judicial Court, Ordway v. City of Newburyport, 119 N. E. 863, overruled the exceptions. The court held that a contractor engaged in the erection of a building is not required by the statute to file the plans; that is the duty of the owner or architect and his failure to comply with the statute does not deprive the contractor of his rights under the contract. The certificate mentioned in the statute is not a condition precedent to recovering by one who supplies material and labor for such a structure. The fact that the inspector had disapproved the plans submitted for the heating of the building—and that this fact was known to the plaintiff—did not deprive him of his right to recover if the work required by the plans and specifications was fully performed. It was found that there was no failure on the plaintiff's part to comply with all the terms of the undertaking. The defect was in the work done by the general contractor, who in building the schoolhouse carried out the original plan and constructed the ducts, as designed, for heating by a hot-air system.

The fact that the defendant was a municipal corporation did not, so far as the statute was concerned, prevent the plaintiff from recovering, nor did the fact that the system was designed and laid out by an engineer of the Wadsworth English Fleet Company, the subcontrator, who was not in the defendant's employ, disclose any fraud or deprive the plaintiff of his right to recover.

Reduction in Calorific Value as Increase in Charge for Gas.

Application having been made by the public Service Company of Northern Illinois for authority to change the present standard quality of gas, permission was granted by the Illinois Public Utilities Commission under certain conditions. The Commission found, among other things, that it was in the interest of the company and of its consumers that the calorific value of the gas furnished by it in the municipalities involved in the proceeding be reduced to one having an average of 565 British thermal units per cubic foot and otherwise in accordance with general order No. 20 of the Commission, and that, should the petition reduce the calorific value of its gas, the rates and charges therefore should be reduced as provided in the order.

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New York School of Heating and Ventilation.

The opening of the New York School of Heating and Ventilation for its sixth annual session is announced by the secretary of the school, G. G. Schmidt. Classes will be held as in previous years on Monday evenings, in Room 511 of the World Building. Charles A. Fuller, M. E., continues as the instructor. No particular requirements as to education and mathematics, it is pointed out, are necessary for the first year course which meets at 7:30 o'clock. Before entering the advanced class, which meets the same evening at 5:45 o'clock, it is desirable to complete the first year's course or to have equivalent qualifications. The cost of each course is $15.00.

MODERN PRACTICE IN VAPOR HEATING

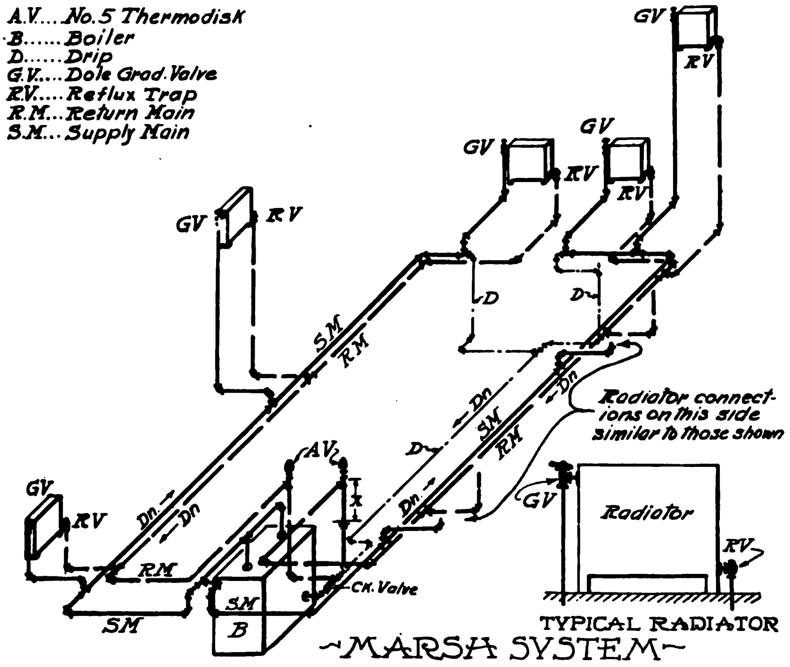
V

THE MARSH SYSTEM.

EDITOR'S NOTE.—*For the purpose of this series of articles, a vapor, vacuum, vapor-vacuum, vacuum-vapor, atmospheric, modulated or thermograde system of heating will be considered as any system in which the steam pressure ordinarily carried is practically at atmosphere, or slightly below, or in which the returns are open to the atmosphere and where no pump or other positive mechanical device is employed to pull back the returns.*

The Marsh system of vapor heating is similar to the typical vapor system illustrated in the first article of this series except in the fact that the return is not opened to the atmosphere direct; instead, the air is relieved through a special vent valve which will be described hereafter.

This system employs the usual hot-water type of radiators and the piping is run in the general style indicated in the typical layout shown in Fig. 1. In this view the steam is generated in any common boiler and passes up through the steam mains and supply risers to the radiator control valves which consist of the Dole packless ball-bearing valve, illustrated in Fig. 2, these valves being made in sizes running from ½-in. to 2-in. The valves are adjusted in the factory to suit the various sizes of radiators to which they are applied, while if any resetting is required after installation a simple loosening of the octagon nut on the top of the valve so as to allow the turning of the dial is all that is necessary.



TYPICAL LAYOUT OF MARSH SYSTEM.

After passing through the radiator the air and condensed steam leave through the return connection passing through the Reflux Junior thermostatic trap. The interior construction of this trap is illustrated in Fig. 3 and it comes in standard pipe sizes from ½-in. to 1-in. inclusive. In shape these valves may be obtained in angle, offset globe, right-hand corner and left-hand corner patterns. They consist of only one movable part, viz., a phosphor-bronze thermostatic diaphragm filled with a special mixture of volatile fluids. These traps are designed to give satisfactory operation up to as high as 15 lbs.

differential which is, of course, much higher than anything obtained with a vapor system. Owing to the use of the traps which prevent steam and vapor getting into the return lines it is unnecessary to increase the radiator surface over that actually required.

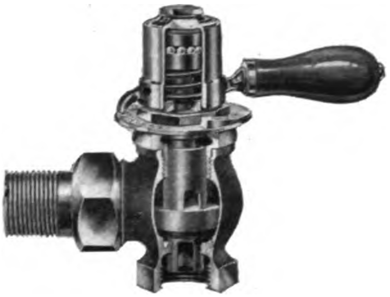


FIG. 2.—DOLE PACKLESS BALL-BEARING VALVE USED WITH MARSH SYSTEM.

The air and condensation then follow down the return line to a point near the boiler where the return line is vented by a No. 5 Thermodisk rapid vent valve, a sectional cut of which is shown in Fig. 4.

This vent valve consists of a valve supported on an expansion disc so as to close when the steam strikes it by the expanding of the disc. An inverted bell-shaped shield acts as float to close the valve when it is filled with water and this prevents blowing out of water through the valve itself. The air is allowed to discharge into the basement and the return sinks down and enters the boiler through a check valve.

The boiler is controlled by means of a sensitive draft regulator and the height of the return line above the boiler water-line is governed by the pressure the system is designed to carry. Thus, if the distance from the boiler water-line to the return main is 28-in. the maximum boiler pressure would be the pressure equal to water head of 28-in. less 8-in. to open the check valve or

$$\frac{28\text{-in.} - 8\text{-in}}{12} \times 0.43 \text{ or}$$

$$\frac{20}{12} \times 0.43 \text{ or}$$

$$1.66 \times 0.43 = 0.713 \text{ lbs. or about } \tfrac{3}{4} \text{ lb.}$$

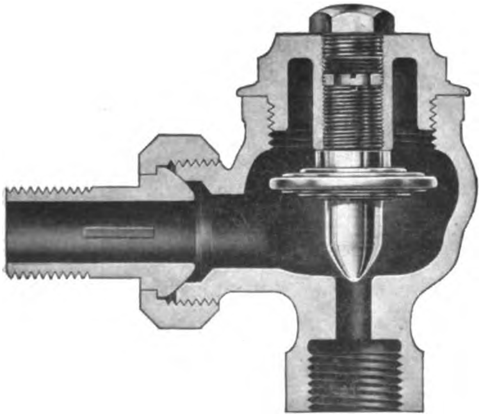


FIG. 3.—CONSTRUCTION OF MARSH REFLUX JUNIOR THERMOSTATIC TRAP.

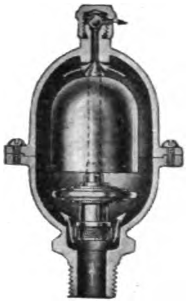


FIG. 4—THERMODISK RAPID VENT VALVE FOR VENTING THE RETURN LINE.

A less difference would decrease the allowable boiler pressure and a greater difference would increase it. The boiler regulator, of course, must be set to maintain a pressure not in excess of that allowable from this varying height in each individual case.

This system is marketed by Jas. P. Marsh & Co., Chicago, Ill.

◆

New Publications.

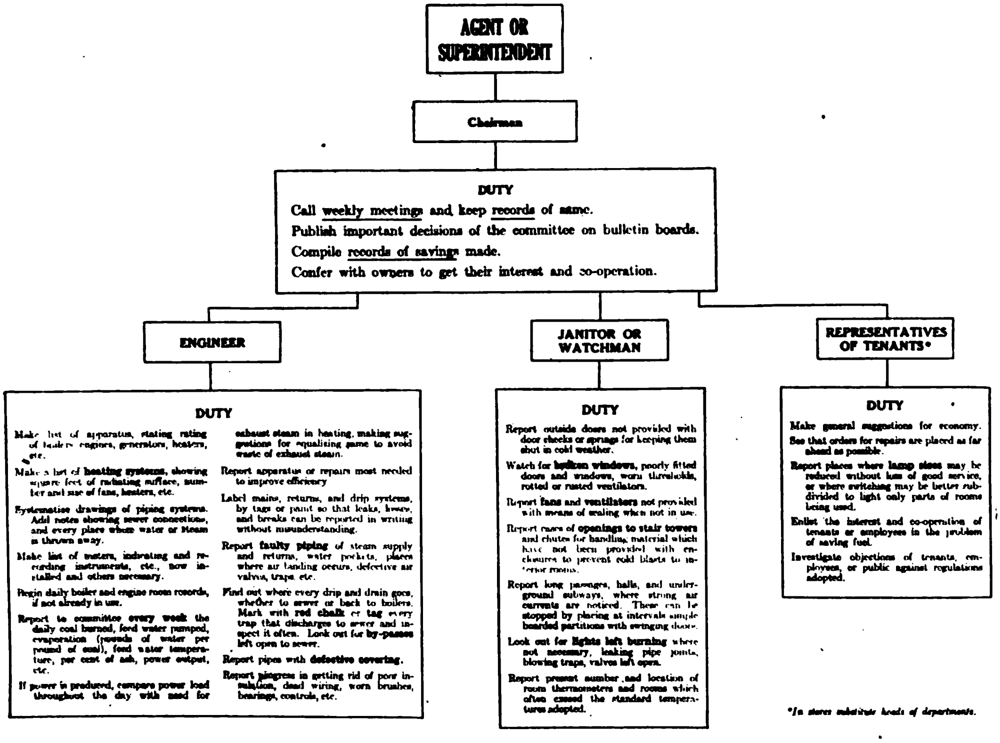
Directory of the American Association of Engineers, giving a brief synopsis of the experience and training of all members of the association, has been published by the American Association of Engineers, 29 South La Salle St., Chicago, Ill. Classified tables have been compiled based on experience, so that it is possible to find a consulting engineer, an executive or a subordinate having specific experience and living in any definite locality. 2204 members are registered in the directory. Cloth, 6 x 9 in. Pp. 192. Price, $2.00.

Rule Relating to Sprinkler Systems (not applicable to the City of New York) has been issued in bulletin form (Bulletin No. 20 of the Industrial Code) by the State Industrial Commission, of the New York Department of Labor. The rule was adopted by the commission July 1, 1918. It covers various types of automatic sprinkler systems, including automatic wet-pipe systems, in which the pipes and sprinkler heads are at all times filled with water; automatic dry-pipe systems, in which the pipes and sprinkler heads are filled with compressed air and the water supply is controlled by a dry-pipe valve; and non-automatic systems in which all pipes and sprinkler heads are maintained dry, with a fire department connection for water supply.

FUEL SAVING IN OFFICE BUILDINGS AND STORES, being Bulletin No. 2 of the Advisory Engineering Committee of the Massachusetts Fuel Administrator, is the title of what has been described as one of the best set of suggestions and rules that have been compiled on this subjejct. The chairman of this committee is Ira N. Hollis. The bulletin starts out by saying that there will be a probable shortage of at least 6,000,000 tons of steam coal in New England. In previous years, states the bulletin, attention has been directed to the boiler and engine room equipment as the chief source of loss, but waste is not confined to these departments. The loss or misuse of heat within a building is just as fatal as the waste of coal in producing the steam.

One of the committee's principal suggestions is the formation of a fuel and power committee in each building, composed of the superintendent of the building, the engineer, head janitor or watchman, and several tenants' representatives. In stores substitute heads of departments. In buildings where the steam plant is used for heating only, a smaller committee will be sufficient. Under "methods for Saving Coal" detailed suggestions are given, applying to the boiler room, engine room, heating system, lighting system, and elevator and other power service, respectively. Special emphasis is laid on the importance of temperature regulation and the advice is given to install thermometers freely. If exhaust steam is used for heating, the advice is to regulate its use just as carefully in mild weather when there is a surplus as when live steam has to be added. In large buildings, says the bulletin, it will pay to have a special watchman to make constant rounds for inspection of windows and valves, and to see that standard temperatures are not exceeded. The value of the sun as a factor in warming buildings has been recognized by shutting off steam on the sunny side. Install shut-off valve, adds the bulletin, so that unused rooms are not heated, and use direct radiators instead of the indirect or fan system of heating by hot air. If the latter is unavoidable, take air from

ORGANIZATION CHART—BUILDING FUEL AND POWER COMMITTEE



AGENT OR SUPERINTENDENT

Chairman

DUTY

Call weekly meetings and keep records of same.
Publish important decisions of the committee on bulletin boards.
Compile records of savings made.
Confer with owners to get their interest and co-operation.

ENGINEER

DUTY

Make list of apparatus, stating rating of boilers engines, generators, heaters, etc.

Make a list of **heating systems**, showing square feet of radiating surface, number and size of fans, heaters, etc.

Systematize drawings of piping systems. Add notes showing sewer connections, and every place where water or steam is thrown away.

Make list of meters, indicating and recording instruments, etc., now installed and others necessary.

Begin daily boiler and engine room records, if not already in use.

Report to committee **every week** the daily coal burned, feed water pumped, evaporation (pounds of water per pound of coal), feed water temperature, per cent of ash, power output, etc.

If power is produced, compare power load throughout the day with need for exhaust steam in heating, making suggestions for equalizing same to avoid waste of exhaust steam.

Report apparatus or repairs most needed to improve efficiency

Label mains, returns, and drip systems, by tags or paint so that leaks, losses, and breaks can be reported in writing without misunderstanding.

Report **faulty piping** of steam supply and returns, water pockets, places where air binding occurs, defective air valves, traps, etc.

Find out where every drip and drain goes, whether to sewer or back to boilers. Mark with **red chalk** or **tag** every trap that discharges to sewer and inspect it often. Look out for **by-passes** left open to sewer.

Report pipes with **defective covering**.

Report progress in getting rid of poor insulation, dead wiring, worn brushes, bearings, controls, etc.

JANITOR OR WATCHMAN

DUTY

Report outside doors not provided with door checks or springs for keeping them shut in cold weather.

Watch for **broken windows**, poorly fitted doors and windows, worn thresholds, rotted or rusted ventilators.

Report **fans and ventilators** not provided with means of sealing when not in use.

Report cases of **openings to stair towers** and chutes for handling material which have not been provided with enclosures to prevent cold blasts to interior rooms.

Report long passages, halls, and underground subways, where strong air currents are noticed. These can be stopped by placing at intervals simple boarded partitions with swinging doors.

Look out for **lights left burning** where not necessary, leaking pipe joints, blowing traps, valves left open.

Report present number and location of room thermometers and rooms which often exceed the standard temperatures adopted.

REPRESENTATIVES OF TENANTS*

DUTY

Make general suggestions for economy.

See that orders for repairs are placed as far ahead as possible.

Report places where **lamp sizes** may be reduced without loss of good service, or where switching may be better subdivided to light only parts of rooms being used.

Enlist the interest and co-operation of tenants or employees in the problem of saving fuel.

Investigate objections of tenants, employees, or public against regulations adopted.

**In stores substitute heads of departments.*

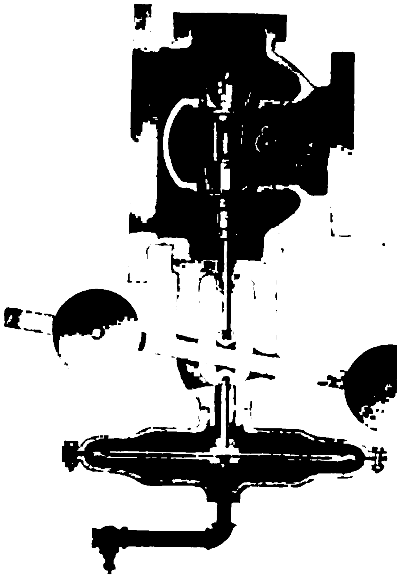
indoors if the design allows. Size 8¼ x 10¾ in. Pp. 8.

METHANE ACCUMULALTIONS FROM INTERRUPTED VENTILATION, with special reference to coal mines in Illinois and Indiana, has been published by the Bureau of Mines as Technical Paper 190. The authors are Howard I. Smith and Robert J. Hamon. The tests shed new light on the much-discussed question of slowing or stopping the mine fan during or previous to shot firing. This has long been the general practice, based on the idea that still air will not propogate an explosion readily. It was also held that when the fan is running, the intake side of the mine, because of the stronger air current there, is the one more susceptible to explosion, and that, in a mine without ventilation the air quickly loses oxygen and gains carbon dioxide, and this change is aided by the products of combustion from the shots fired until the danger of explosions being propagated is greatly reduced. It has been further held that where air is traveling through a mine at high velocity there is a greater quantity of air in the mine at any one time, consequently a greater chance for propogation of explosions, also that in still air inflammable dust disturbed by one blast is not liable to be carried to any place where another blast may ignite it easily. It is in the present tests that some of these reasons are not valid and others hold good in particular cases only. The danger of slowing down the fans, moreover, is found to be exceedingly dangerous, the facts indicating that in districts where this practice is tolerated there have been more explosions than in any other districts in the United States. The authors' conclusion is that if methane is present, even in small percentages, interrupted ventilation in a mine means the certain increase of a known danger for the elimination of a less serious one. Size 6 x 9 in. Pp. 46.

THE TARS DISTILLED FROM BITUMINOUS COAL IN HAND-FIRED FURNACES are discussed in Technical Paper 195, issued by the Bureau of Mines, under the authorship of S. H. Katz. This paper deals especially with the liquid or tar part, at ordinary temperatures, of the volatile matter evolved in a coal fire. The samples of tar examined were taken, in one case, from points within the fuel bed where the coal was burning at low rates, and in other cases, from points on the surface of the fuel bed burning at a moderately rapid rate in a large hot furnace. The following are among the conclusions given: (1) When bituminous coal in quantities to last for a period of hours is added to a slowly-burning fire, tar may be found in the gases within the fuel bed through a considerable part of the time the coal is burning; (2) when coal is added to fires in uniform quantities and at short, regular intervals, the greatest quantity of tar in the gases is at the surface of the bed; (3) at a point 1 ft. above the bed of bituminous coal burning in a large, hot furnace at moderately rapid rates, practically all tar had disappeared. Size 6 x 9 in. Pp. 20.

Trade Literature.

ECLIPSE STEAM SPECIALTIES, described as "the standard for over a quarter of a century," are featured in Bulletin No. 101, issued by the Illinois Engineering Co., manufacturing engineers, Chicago, Ill. This is the well-known line that was marketed for many years by the Hughson-John Davis Company, and includes various types of pressure-regulating valves for vacuum, low and high-pressure work, air-regulating valves, automatic water regulators and central station reducing valves. A notable feature of the pressure-regulating valve for low-pressure heating is the arrangement of the piston which is automatically adjustable and self-compensating for variable temperature conditions, so that these valves remain tight under varying pressures. The bulletin describes and illustrates the various type in detail, giving the necessary information for the user. Size 6 x 9 in. (standard). Pp. 24.

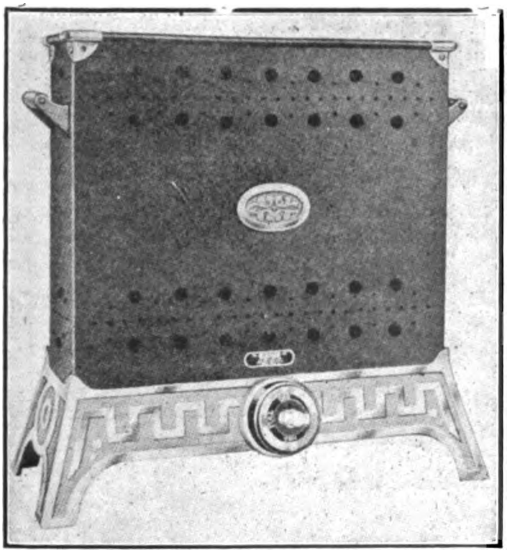


CONSTRUCTION OF ECLIPSE VACUUM-HEATING PRESSURE-REGULATING VALVE.

Sirocco Service for July, 1918, published by the American Blower Co., Detroit, Mich., has an interesting article on the electrification of the Chicago, Milwaukee & St. Paul Railroad. In the electrification plant which includes 14 sub-stations 30 miles apart, sixteen Sirocco blower equipments are installed on the Missoula Division, comprising seven sub-stations. A further extension will use additional Sirocco units. Sirocco blowers are used in this connection for the cooling of the generators. Other articles in this issue describe the equipment of the Hotel Winton, Cleveland, and the building of Uncle Sam's big fleet of merchant ships. A large number of Sirocco ventilating equipments, it is stated, are installed on these ships.

Natural Ventilation for Foundries is the title of a catalogue issued by the Detroit Steel Products Co., Detroit, Mich., devoted to Fenestra steel sash construction. Size 5 x 5½ x 8½ in. Pp. 16.

General Electric Type Heating Appliances are the subject of a new catalogue, issued by the Edison Electric Appliance Co., Chicago, showing the remarkable range which this kind of appliance now covers. One of these appliances is an electric air heater designed for use in the home, office, factory, etc. It is made of black enamel steel on a cast-iron nickle-plated base and is fitted with cool handles for carrying. According to the instructions given, 1 to 1½ watts per cubic foot should be allowed for heating rooms in moderate climates, and 2½ to 4 watts in extreme climates. The heaters weigh from 20 to 42 lbs. and are made in ten sizes from 1000 to 5000 watts.



NEW TYPE OF ELECTRIC AIR HEATER.

Death of Professor William Kent.

William Kent, author of Kent's Engineer's Handbook, and a former president of The American Society of Heating and Ventilating Engineers, died at Gananoque, Ont., where he was spending the summer, September 18. Professor Kent was 68 years old. His passing removes one more of the "old guard" of the heating profession, for although better known as an expert in the power field, he had taken a deep and long-continued interest in the devolopment of the art of heating and ventilation and had contributed much, in the way of papers and through committee work, towards the advancement of the art.

Some of the most active years in the life of Professor Kent were spent at the L. C. Smith College of Applied Sciences of Syracuse University, where he held the position of dean. In recent years his time was given over largely to lecturing on mechanical subjects in various colleges.

Probably Professor Kent's best title to fame will rest in his "Mechanical Engineers' Pocketbook," which is known and used wherever American engineering enterprises are carried on. This work is now in its ninth edition.

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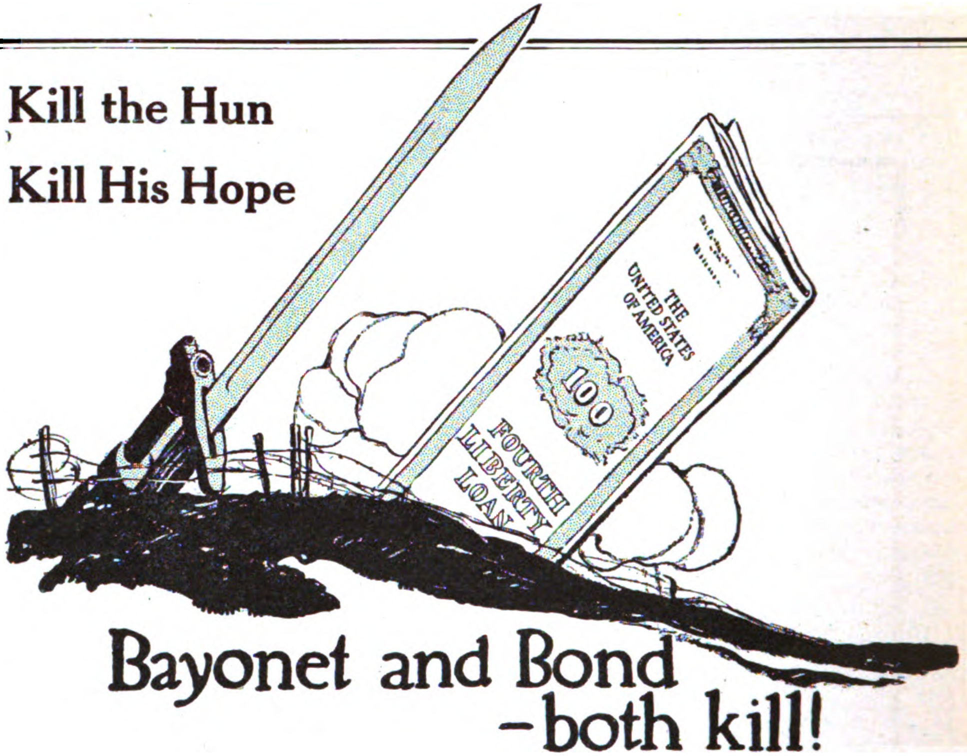
Deaths.

George W. Mackay, Montreal, Canada, a brother of William M. Mackay, of New York, and of the late James Mackay, of Chicago, died at his home in Montreal August 16. He was 44 years old. Mr. Mackay went overseas with the first Canadian contingent and was gassed and wounded while fighting in Belgium. His son was killed in he same action. For the past two years he as been in various hospitals in England, rance, Scotland and Canada.

Patrick Nacey, president and founder of he P. Nacey Co., Chicago, heating and lumbing engineers and contractors, died at t. Bernard's Hospital in that city August 1. He was 76 years old. He is survived y his son, Harry M. Nacey, who will carry n the business.

◆

A modern dehydrating plant has been intalled at the War Food Bureau in Baltiore, Md., which is being used to take care f the produce from the war gardens in hat State. The plant is of the simple ryer type, without fans, and is intended artly as a demonstration of what can be complished on the farm with a simple dying outfit, the principal features being a series of wire trays and a small stove.



ONE KILLS the Hun, the other kills his hope. And to kill his hope of victory is as essential right now as to kill his fighting hordes. For while hope lasts, the Wolf of Prussia will force his subject soldiers to the fighting line.

We have floated other loans, built a great fleet of ships, sunk pirate submarines, sent our men across and shown the Kaiser's generals what American dash and grit and initiative can do. The Hun has felt the sting of our bullets and the thrust of our bayonets. He is beginning to understand America Aroused—to dread the weight of our arms and energy.

This is a crucial moment. Nothing can so smother the Hun morale, so blast his hopes, as a further message from a hundred million Freemen, a message that says in tones that cannot be misunderstood, "Our lives, our dollars, our ALL—these are in the fight for that Liberty which was made sacred by the sacrifices of our forefathers."

Buy U. S. Government Bonds Fourth Liberty Loan

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This space contributed for the Winning of the War by

The Publisher of
THE HEATING AND VENTILATING MAGAZINE

EQUIVALENT HOT BLAST TEMPERATURES

FOR OTHER TEMPERATURES THAN ZERO

The temperature that a hot blast system under test should maintain when the outside temperature is other than zero may be obtained from the formula

$$T = \frac{t_g\,(t_s - t_o) + t_s\,(t_o - t_{os})}{t_s - t_{os}}$$

when T is the resultant building temperature when the outside temperature is t_o,

t_g the guaranteed building temperature at a specified outside temperature (t_{os}),

t_{os} the outside temperature specified,

t_s the temperature of the steam at the pressure stipulated,

t_o the actual outside temperature.

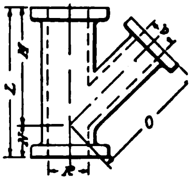
From this formula Table I has been calculated and shows what temperature should be reached for any guarantee with any outside temperature.

TABLE I.

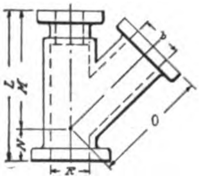
Outside Temp. to Deg. F.	Average Indoor Temperature—T Deg. F.							
—20	45.2	50.8	56.1	61.6	67.1	72.5	77.9	83.4
—15	48.9	54.3	59.7	64.9	70.3	75.6	80.9	87.3
—10	52.9	57.9	63.1	68.3	73.5	78.7	86.0	89.2
— 5	56.3	61.4	66.5	71.6	76.8	81.9	87.0	92.1
0	60.	65.	70.	75.	80.	85.	90.	95.
5	63.7	68.6	73.5	78.4	83.2	88.1	93.0	97.9
10	67.4	72.1	76.9	81.7	86.5	91.3	96.0	100.8
15	71.0	75.7	80.3	85.1	89.7	94.4	99.1	103.7
20	74.7	79.3	83.9	88.4	92.9	97.5	102.1	106.6
25	78.4	82.9	87.3	91.8	96.2	100.7	105.1	109.5
30	82.1	86.4	90.8	94.1	99.4	103.8	108.1	112.4
35	85.8	90.0	94.3	97.5	102.6	106.9	111.2	115.3
40	89.4	93.6	97.7	101.8	105.9	110.0	114.2	118.2
45	93.1	97.1	101.2	105.4	109.1	113.2	117.2	121.1
50	96.8	100.7	104.7	108.5	112.4	116.3	120.2	124.0
55	100.5	104.3	108.1	111.9	115.6	119.4	123.3	126.9
60	104.2	107.8	111.6	115.2	118.8	122.6	126.3	129.8
65	107.8	111.4	115.0	118.6	122.1	125.7	129.3	132.7
70	111.5	115.0	118.5	121.9	125.3	128.8	132.4	135.6

(Buffalo Forge Co.)

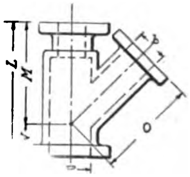
1915 STANDARD WEIGHT FLANGED REDUCING LATERALS.



Reducing Lateral.



Reducing-on-Run Lateral.

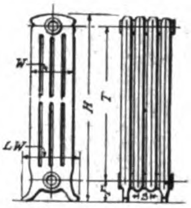


Reducing-on-Run-and Branch Lateral.

Size, In. Diam.		Dimensions, In.				Flanges	
R	Branch b	L	M	N	O	Dia. In.	Thickness In.
1	—	—	—	—	—	4	7/16
1¼	1¼ or less	8	6¼	1¾	6¼	4½	½
1½	1½ " "	9	7	2	7	5	9/16
2	2 " "	10½	8	2½	8	6	⅝
2½	2½ " "	12	9½	2½	9½	7	11/16
3	3 " "	13	10	3	10	7½	¾
3½	3½ " "	14½	11½	3	11½	8½	13/16
4	4 " "	15	12	3	12	9	15/16
4½	4½ " "	15½	12½	3	12½	9¼	15/16
5	5 " "	17	13½	3½	13½	10	15/16
6	6 " "	18	14½	3½	14½	11	1
7	7 " "	20½	16½	4	16½	12½	1 1/16
8	8 " "	22	17½	4½	17½	13½	1⅛
9	9 " "	24	19½	4½	19½	15	1⅛
10	10 " "	25½	20½	5	20½	16	1 3/16
12	12 " "	30	24½	5½	24½	19	1¼
14	14 " "	33	27	6	27	21	1⅜
15	15 " "	34½	28½	6	28½	22¼	1⅜
16	16 " "	36½	30	6½	30	23½	1 7/16
18	9 " "	26	25	1	27½	25	1 9/16
18	18 to 10 inc.	39	32	7	32	25	1 9/16
20	10 and less	28	27	1	29½	27½	1 11/16
20	20 to 12 inc.	43	35	8	35	27½	1 11/16
22	10 and less	29	28½	½	31½	29½	1 13/16
22	22 to 12 inc.	46	37½	8½	37½	29½	1 13/16
24	12 and less	32	31½	½	34½	32	1⅞
24	24 to 14 inc.	49½	40½	9	40½	32	1⅞
26	12 and less	35	35	0	38	34¼	2
26	26 to 14 inc.	53	44	9	44	34¼	2
28	14 and less	37	37	0	40	36½	2 1/16
28	28 to 15 inc.	56	46½	9½	46½	36½	2 1/16
30	15 and less	39	39	0	42	38¾	2⅛
30	30 to 16 inc.	59	49	10	49	38¾	2⅛

UNITED STATES RADIATOR CORPORATION'S 3-COLUMN FLORENTINE RADIATORS FOR STEAM AND WATER.

No. of Sections	*Length Inches	Heating Surface					
		45 Inch Height 6 Sq. Feet per Sect'n	38 Inch Height 5 Sq. Feet per Sect'n	32 Inch Height 4½ Square Feet per Section	26 Inch Height 3¾ Square Feet per Section	22 Inch Height 3 Square Feet per Section	18 Inch Height 2¼ Square Feet per Section
2	5	12	10	9	7½	6	4½
3	7½	18	15	13½	11¼	9	6¾
4	10	24	20	18	15	12	9
5	12½	30	25	22½	18¾	15	11¼
6	15	36	30	27	22½	18	13½
7	17½	42	35	31½	26¼	21	15¾
8	20	48	40	36	30	24	18
9	22½	54	45	40½	33¾	27	20¼
10	25	60	50	45	37½	30	22½
11	27½	66	55	49½	41¼	33	24¾
12	30	72	60	54	45	36	27
13	32½	78	65	58½	48¾	39	29¼
14	35	84	70	63	52½	42	31½
15	37½	90	75	67½	56¼	45	33¾
16	40	96	80	72	60	48	36
17	42½	102	85	76½	63¾	51	38¼
18	45	108	90	81	67½	54	40½
19	47½	114	95	85½	71¼	57	42¾
20	50	120	100	90	75	60	45
21	52½	126	105	94½	78¾	63	47¼
22	55	132	110	99	82½	66	49½
23	57½	138	115	103½	86¼	69	51¾
24	60	144	120	108	90	72	54
25	62½	150	125	112½	93¾	75	56¼



Note—Add 1/2 in for each bushing to get total lenght of radiator.
H = Total over all height.
T = C. to C. of tappings
F = Floor to center of bottom tapping.
W = Width of radiator—9 in.
LW = Width of radiator legs—9 5/16 in.
S — Width of radiator sections, i. e., to of sections—2 1/2 in.

Nominal Height of Radiator In.	Actual Height H In.	Steam Supply and Return F In.	Steam Supply and Return T In.	Water Supply and Return F In.	Water Supply and Return T In.
45	45	4	38 3/8	4 1/2	37 7/8
38	38	4	31 9/16	4 1/2	31 1/16
32	32	4	25 9/16	4 1/2	25 1/16
26	26	4	19 5/8	4 1/2	19 1/8
22	22	4	15 5/8	4 1/2	15 1/8
18	18	4	11 3/4	4 1/2	11 1/4

For high legs F. equals 6 in. and H. is increased 2 in. for steam of 1 1/2 in. for water.
For legless radiators deduct 2 1/2 in. from F. and H.

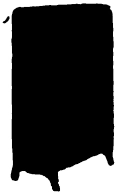
TAPPING DATA

All radiators are tapped 2 in. and bushed as follows:

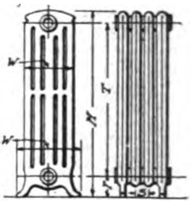
SYSTEM	Size of Radiator Square Feet	Supply In. Diam.	Return In. Diam.
Steam, one-pipe	Up to 24 sq. ft. in.	1	
	Over 24 up to 60 inc.	1 1/4	
	Over 60 up to 100 inc.	1 1/2	
	Above 100 sq. ft.	2	
Steam, two-pipe	Up to 48 sq. ft. inc.	1	3/4
	Over 48 up to 96 inc.	1 1/4	1
	Above 96 sq. ft.	1 1/2	1 1/4
Water	Up to 40 sq. ft. inc.	1	1
	Over 40 up to 72 inc.	1 1/4	1 1/4
	Above 72 sq. ft.	1 1/2	1 1/2

All air valve tappings are 1/8 in.
Vapor tappings as instructed only.
All tappings with R. H. threads unless otherwise ordered.

UNITED STATES RADIATOR CORPORATION'S 4-COLUMN FLORENTINE RADIATORS FOR STEAM AND WATER.



No. of Sections	*Length Inches	Heating Surface					
		44 Inch Height 10 Sq. Feet per Sect'n	38 Inch Height 8½ Square Feet per Section	32 Inch Height 7 Sq Feet per Sect'n	26 Inch Height 5½ Square Feet per Section	22 Inch Height 4½ Square Feet per Section	18 Inch Height 3½ Square Feet per Section
2	6	20	17	14	11	9	7
3	9	30	25½	21	16½	13½	10½
4	12	40	34	28	22	18	14
5	15	50	42½	35	27½	22½	17½
6	18	60	51	42	33	27	21
7	21	70	59½	49	38½	31½	24½
8	24	80	68	56	44	36	28
9	27	90	76½	63	49½	40½	31½
10	30	100	85	70	55	45	35
11	33	110	93½	77	60½	49½	38½
12	36	120	102	84	66	54	42
13	39	130	110½	91	71½	58½	45½
14	42	140	119	98	77	63	49
15	45	150	127½	105	82½	67½	52½
16	48	160	136	112	88	72	56
17	51	170	144½	119	93½	76½	59½
18	54	180	153	126	99	81	63
19	57	190	161½	133	104½	85½	66½
20	60	200	170	140	110	90	70
21	63	210	178½	147	115½	94½	73½
22	66	220	187	154	121	99	77
23	69	230	195½	161	126½	103½	80½
24	72	240	204	168	132	108	84
25	75	250	212½	175	137½	112½	87½



Note—Add 1/2 in. for each bushing to get total length of radiator.

H = Total over all height.
T = C. to C. of tappings.
F = Floor to center of bottom tapping.
W = Width of radiator—12 1/2 in.
LW = Width of radiator legs—12 13/16 in.
S = Width of radiator sections, i. e., to of sections—3 in.

Nominal Height of Radiator In.	Actual Height H In.	Both Steam and Water Supply and Return F In.	T In.
44	44	4 1/2	36 15/16
38	38	4 1/2	31 1/16
32	32	4 1/2	25 1/16
26	26	4 1/2	19 1/8
22	22	4 1/2	15 1/8
18	18	4 1/2	11 1/4

For high legs F. equals 6 in. and H. is increased 1 1/2 in.
For legless radiators deduct 2 1/2 in. from F and H.

TAPPING DATA

All radiators are tapped 2 in. and bushed as follows:

SYSTEM	Size of Radiator Square Feet	Supply F In. Diam	Return F In. Diam.
Steam, one-pipe	Up to 24 sq. ft. inc.	1	
	Over 24 up to 60 inc.	1 1/4	
	Over 60 up to 100 inc.	1 1/2	
	Above 100 sq. ft.	2	
Steam, two-pipe	Up to 48 sq. ft., inc.	1	3/4
	Over 48 up to 96 inc.	1 1/4	1
	Above 96 sq. ft.	1 1/2	1 1/4
Water	Up to 40 sq. ft., inc.	1	1
	Over 40 up to 72 inc.	1 1/4	1 1/4
	Above 72 sq. ft.	1 1/2	1 1/2

All air valve tappings are 1/8 in.
Vapor tappings as instructed only.
All tappings with R. H. Threads unless otherwise ordered.

THE HEATING AND VENTILATING MAGAZINE

Cooperstown, N. Y. November, 1918 1123 Broadway, New York

ENGLAND'S FUEL-RATIONING ORDER

Provisions of New Regulations Limiting the Supply of Coal, Gas and Electricity to Domestic Consumers.

Great Britain has come to the rationing of coal and gas to the people throughout England and Wales. The new order, which is known as "The Household Fuel and Lighting Order" is dated June 28, 1918, and was promulgated by the Board of Trade under Defence of the Realm regulations.

The order extends to coal, gas, and electricity used for heating or cooking or for any other than industrial purposes, exclusive of lighting. It also extends to gas and electricity used for lighting purposes in connection with certain classes of buildings mentioned in the order. Where an industry is carried on in a dwelling house for instance, then such industry must comply with the order. The same is true of private plants for the generation of gas or electricity for consumption in a house. Laundries, bakehouses, dairies, greenhouses and industrial occupations of a domestic or quasi-domestic character are included, as are those premises where the total quantity of coal or its equivalent to be used in any year does not exceed 100 tons.

Coal is defined in the order as anthracite and all other kinds of which coke is a constituent. Fuel means coal, gas and electricity used for all purposes except lighting.

ALLOWANCES FOR FUEL AND LIGHTING.

Following are the allowances of fuel for dwelling houses, or flats or tenements in separate occupation, such allowances running for one year calculated from July 1:

Where the number of rooms occupied is:	The fuel allowance for the year shall not exceed:			
	A		B	
	Tons	Cwts.	Tons	Cwts.
Not more than 2....	3	10	3	0
3..................	4	0	3	10
4..................	4	10	4	0
5..................	5	0	4	10
6..................	6	0	5	0
7..................	7	0	6	0
8..................	8	0	7	0
9..................	9	0	8	0
10..................	10	0	9	0
11..................	11	0	10	0
12..................	12	0	11	0

and for every additional room 1 ton until a maximum of 20 tons is reached, thereafter any additional allowance not exceeding 1 ton per room shall be in the discretion of the local fuel overseer. Provided always that where the number of people habitually resident in a flat or tenement, etc., of not more than 12 rooms exceeds six, the scale allowance as determined by the foregoing table shall be increased 1 ton.

The two scales indicated in the table refer roughly to the northern and southern sections of England, respectively. Wales is inluded in Scale A.

Consumers may take the allowance of fuel to which they are entitled either in coal, gas or electricity in accordance with the following rules:

(A) Anthracite shall count as fuel at the same rate as ordinary coal.

(B) Three tons of coke shall count as two tons of fuel, and so in proportion for other quantities.

(C) Briquettes not sold by weight and not exceeding 2½ lbs. each shall count as 1000 to the ton and so in proportion.

(D) 15,000 cu. ft. of gas shall count as one ton of fuel.

(E) 800 Board of Trade units of electricity shall count as one ton of fuel.

The quantity of fuel to be taken must be calculated to the nearest quarter of a ton. The allowance of fuel to be taken as coal shall not be less in any case than 2 tons, 10 cwts. Any quantity of fuel allowed in addition to 20 tons may be required to be taken either wholly or partly in coke.

ALLOWANCES FOR LIGHTING

In addition to the allowances for fuel, there is allowed for lighting the quantities of gas and electricity shown in the following table:

Where the number of rooms occupied is	The lighting allowance for the year shall not exceed either cu. ft. of gas	or B. of T. units of electricity
1, 2 or 3	7,500	120
4, 5 or 6	11,250	180
7, 8 or 9	15,000	240
10, 11 or 12	18,750	300
13, 14 or 15	22,500	360
16, 17 or 18	26,250	420
19, 20 or 21	30,000	480

Gas or electricity allowed for lighting under this clause may, at the option of the consumer, be used for other domestic purposes, but cannot be converted into coal. Where gas and electricity are both used for lighting the consumer may elect to take part of the allowance as gas and part as electricity, 750 cu. ft. of gas being taken, for this purpose, as equivalent to 12 B. of T. units of electricity and vice versa.

Rooms shall only count where furnished and in actual occupation, except that bedrooms furnished, but only occasionally occupied, shall count as rooms. The following shall not count as rooms: Sculleries, bathrooms, halls not used as sitting rooms, dressing rooms not used as bedrooms, boxrooms, cellars, pantries not containing fireplaces or stoves, storerooms, greenhouses attached to houses, and outbuildings.

Unoccupied dwellings, of course, are not considered and the allowance is cut down when there is a temporary cessation of occupation exceeding one month; also where a consumer has more than one place of residence.

Not more than one-third of the total allowance of gas and electricity for fuel or lighting purposes may be taken in any one-quarter of the year except in cases where the quarter appreciably exceeds a three-monthly period.

WHEN ADDITIONAL ALLOWANCES MAY BE GRANTED.

Additional allowances not exceeding 5 tons of fuel in a year may be granted to a household where the absence of an additional fire or additional heating or cooking or lighting is shown to cause material hardship on all or any of the following grounds:

1. The presence of aged or infirm persons, invalids or young children.
2. The occupation of separate rooms by lodgers.
3. The use of rooms for a business or profession in a dwelling house or other building used in connection therewith.
4. The necessity for the upkeep of fires and light during the night as well as the day by reason of the hours during which the householder or other resident is engaged at work.
5. Illness, but in this case the allowance shall be of a temporary character and a medical certificate is required.

Any additional allowance shall be in fuel or in such specific fuel as coal, coke, gas or electricity as the local fuel overseer may determine. An additional allowance or part thereof may be used for lighting.

Further additional allowances not exceeding 5 tons of fuel in a year may be granted on the application of householders where the supply is required for actual consumption in connection with any industrial or manufacturing process carried on in a dwelling house, such allowance to be distinct from the allowance just mentioned.

The occupier of a dwelling house or tenement exceeding 15 rooms, or the occupier* of any building not used or only partly used as a dwelling house may make application to be assessed individually, having regard to his special requirements. In such cases there is required, among other things, the figures for his previous consumption within one or more of the three previous years. Such applicant may receive the maximum allotment.

ALLOTMENTS IN SPECIAL CASES.

The difficulty of making a general rule that will cover all cases is illustrated in one clause where the allotments of fuel and lighting supplies may be made in a "single assessment." Such cases include residential estates or farms where fuel and light is supplied to the tenants, to a block of flats or tenements where heat and light is supplied by the proprietor or manager, to a group of houses managed on a communal basis, to a dwelling house occupied by more than one household in common and to a dwelling house part of which is occupied by a sub-tenant.

Another special case is where fuel is required for the generation or production of gas and electricity not for public sale but for consumption in a building covered by the order. The order states that the allowance of fuel for such purpose shall be limited to the amount actually required for this purpose and that the fuel so allowed shall not be applied to any other purpose.

Fuel required for industrial purposes not within the scope of the order may be purchased with household fuel and in addition thereto, upon the declaration of the consumer as to the industrial purposes for which it is required.

Where it is known that an occupation is only temporary the order provides that allowances shall be for one or more months, in the discretion of the local fuel overseer, and shall be renewed from time to time. Also where the local fuel overseer has reason to believe that in any premises fuel or light or both are being consumed at an unreasonable rate, he may cancel the yearly allowance and in its place grant and renew from time to time an allowance of one or more months.

HOW THE REGULATIONS ARE ADMINISTERED.

In administering the provisions of the order a "local fuel overseer" is appointed for each locality by the local authorities. They are also to appoint a "local fuel and lighting committee" to be constituted as follows:

One member who shall undertake the duties of "coal merchants' supervisor" to be named by the coal merchants within the district; one member to be named by the coal dealers within the district; one member to be named by the gas companies and one member to be named by the electric companies.

If the local authority desires, one member may be named by the railway company having sidings through which coal is supplied within the district. The same applies to canal companies and similar carriers, but where such appointments are made an equal number is appointed by the local authorities. The local fuel overseer is also a member of the committee.

The general application of the order is under the supervision of the Controller of Coal Mines who is appointed by the Board of Trade.

HOW ALLOTMENTS ARE MADE.

Each fuel and light consumer is required to fill out an application which is then sent to a registered coal merchant or coal dealer. It is not necessary that the same coal merchant or dealer shall supply both coal and coke. The coal merchant or dealer then signs the application and certifies to the correctness of any particulars given by the consumer within his knowledge.

Each consumer is required to fill out an application for both fuel and light. The application for coal or coke, or both, are sent to a registered coal merchant or coal dealer. It is not necessary that the same coal merchant or dealer shall supply both the coal and coke called for in the application. The coal merchant or dealer then signs the application and certifies to the correctness of any particulars given by the consumer within his knowledge. Where gas or electricity is supplied by public gas companies, such company is deemed to have accepted the application for gas and electricity to such premises without further formality.

The application is then sent to the local fuel overseer who issues a requisition for fuel and lighting. This requisition provides separately for the delivery of coal, coke, gas and electricity, and the consumer elects in what form and proportion he desires to take his fuel and lighting allowances. The allowance of gas and electricity for lighting is added to the allowance of gas and electricity for fuel and the consumer may use such total allowance either for fuel or lighting as he desires.

The consumer may be required to give full particulars as to his premises, included the purpose for which fuel is required, previous consumption of fuel and light, coal and coke on hand available for use and other necessary particulars.

After satisfying himself that the particulars shown on a requisition are correct and agree with the application, the local fuel overseer issues certificates to the registered coal merchants or licensed coal dealers named thereon to supply such proper quantities of coal and coke required by the requisition and at the same time issue certificates to the gas or electricity companies for the supply of the proper quantities of gas and electricity.

A requisition does not in itself impose any obligation on a consumer to purchase the quantity of fuel and light stated, nor does the acceptance of a requisition by the coal merchant or coal dealer constitute a contract for the supply of the quantity of coal or coke stated. This also applies to the gas and electric companies.

When a registered coal merchant or licensed coal dealer has completed the delivery of coal or coke to any consumer he completes the declaration to that effect provided in the form of certificate and returns it to the local fuel overseer. Such consumer cannot then obtain any further supplies for that year except with the express permission of the local fuel overseer.

DUTIES OF CONSUMER.

Among the restrictions laid on the consumer is one that he must not consume in any quarter gas or electricity to an amount exceeding one-third of the total yearly amount. The stock of coal in his possession at the date of the requisition shall be deemed to be in full or part satisfaction for the coal requirements for the year. A consumer must not have in his possession at any time more coal than is sufficient to satisfy his allowance for a period of 12 months, and coal shall not be acquired for stock during the period from October 1 to April 30 without the assent of the local fuel overseer.

FIXING COAL PRICES.

The local fuel and lighting committee, with the approval of the Controller, may from time to time determine the maximum prices of coal to consumers. In determining the maximum prices of coal, it is to be divided into classes or qualities following the usual practice of the trade and sold in accordance with such classes, but the Controller may require the coal to be mixed. A notice of maximum prices for both coal and coke shall be exhibited in a conspicuous position in all places where orders for coal are received and the charging of prices in accordance with such notice shall be conclusive evidence that such prices are approved and are correct.

PROPOSED COAL-RATIONING RULES FOR THE UNITED STATES

Allowances Designed for Heating, Cooking and Hot-Water Service in Residences, Flats and Apartment Houses.

(Final Draft of Report of Committee on Fuel Conservation, American Society of Heating and Ventilating Engineers.)

NOTE.—*The following rules are intended to apply not only to residences, flats and apartment houses, but to other buildings of residence where coal is used for heating, cooking and hot-water service and where a power plant is not in operation.*

The allowance of coal for heating purposes shall be made on the basis of the number of rooms heated, taking into account the locality, the number and age of persons occupying the rooms, living conditions, and the application of consistent judgment for determining the number of rooms upon which the allowance should be made.

The allowance of coal per family for cooking and hot-water service is determined by the number in family and reasonable conditions of use and requirement based upon established rulings.

RULE 1.—If a family require for its own personal use six tons of coal or less for heating and cooking purposes per season, the local Fuel Administrator may approve their application so that they will receive the full amount, without regard to the following rules.

RULE 2.—The basis of allowance of coal for heating per room per heating season shall be 1 ton for apartment houses or houses with two sides protected; ½ ton for houses with one side protected; 1⅓ tons for detached houses.

a. This allowance is the maximum where there are no children under 5 years, adults over 60 years of age, or invalids.

b. It is impractical to require heat to be shut off from rooms not necessary for family use, but allowance for coal for heating such rooms may be withheld by the local Fuel Administrator.

RULE 3.—In any locality having a higher average normal temperature than 40° F. for the months of Oct. 1 to May 1, as given by the nearest U. S. Weather Bureau station, the allowance of coal shall be 3% less for each degree that such average normal temperature is in excess of 40°. Likewise, in any locality having a lower average normal temperature than 40° F., the allowance of coal may be increased 3% for each degree that such average normal temperature is less than 40°.

RULE 4.—Rule 2 contemplates only a reasonable allowance of rooms in general family use, including living rooms, libraries, dining-rooms, kitchens without coal ranges, necessary sleeping rooms, baths and pantries. Pantries or bathrooms are to be considered as one-half rooms each. In houses with three or four sides exposed, an allowance of one room shall be made for general halls and stairways.

RULE 5. Wherever occupants include children under 5 years, adults over 60 years of age, or invalids, the allowance of coal per room for heating may be increased 10%.

RULE 6. For cooking and hot-water service, the allowance per month is dependent upon the number in the family including boarders and servants, and shall be in accordance with the accompanying table:

The Committee's Letter of Transmittal.

Mr. O. P. Hood, Mechanical Engineer, Bureau of Mines, Department of the Interior, Pittsburgh, Pa.

Dear Sir:

The committee appointed in accordance with your letter of January 30, addressed to The American Society of Heating and Ventilating Engineers, has the honor to submit the attached set of rules for covering the limitations.

We wish to inform you that the committee appreciates the great variation in the heating requirements for domestic buildings, such as the size and exposure of rooms, construction and location of buildings, method of heating and condition of heating equipment, climatic condition of the location, quality of coal, efficiency of firing, together with the further complications of the extra fuel required for cooking and hot-water service.

We realize that the rules presented are open to criticism in that they are not based on scientific calculations, taking into account all of these variable factors, but the immense amount of technical as well as clerical work that would be required for the application of any very scientific calculations seemed to us to exclude a more complicated scheme.

All things considered, we are inclined to believe that it will be found that a simple set of rules similar to those suggested will come nearer filling the conditions than any other that we could provide.

It is probable that the rules may work greater hardships on large detached residences having a large number of living rooms, libraries, parlors, etc., with but comparatively a small number of sleeping rooms occupied, than upon any other class of buildings. We are also inclined to believe that there is a greater opportunity for saving coal in this than in any other class of domestic buildings. We do not recommend, therefore, that any special rule be made to cover these cases.

We have compared amounts of coal allowed under these rules with the actual amount burned in several hundred dwellings of all classes in almost every State of the Union. It is quite evident from our comparison that the personal factor of the operator of the heating system has a greater bearing than any other single factor; also the mental attitude of the occupants and their desire to maintain reasonably low temperatures and the closing up of the rooms not necessary to be heated has a greater effect upon the amount of fuel used than does the climate. The amount of coal allowed in the rules for many apartment houses, flats and other buildings for heating of water is considerably less than that normally used, but it seems that this saving may be effected without undue hardship.

Your particular attention is called to the desirability of a set of rules for the operation of domestic heating apparatus, and we suggest that some national organization be enlisted to see that proper operating methods are carried out. It would seem to us that such an organization as our newly-formed National Guard or Home Defense League, working in co-operation with heating manufacturers, heating engineers and heating trade, could be used for this work, as we believe that they could do no more patriotic service than the inspection of domestic buildings of all kinds to see that the heating apparatus and its operation conform to the rules suggested. They could make reports to the local Fuel Commissioner who could bring pressure to bear upon the consumer to operate his plant with the greatest efficiency.

Respectfully submitted,

J. I. Lyle,
Chairman.

ALLOWANCE OF COAL FOR COOKING AND HOT-WATER SERVICE.

Number of Persons	Maximum Coal Allowance for Cooking and Hot-Water Service where Range has Water Back, Pounds	Maximum Coal Allowance for Cooking only when range is not equipped with Hot-Water Back, Pounds	Maximum Coal Allowance for Hot-Water Service only when same is supplied by Separate Apparatus, Pounds
3	750	600	500
4	850	650	550
5	950	700	600
6	1050	750	650
7	1150	800	700
8	1250	850	750
9	1350	900	800
10	1450	950	850

NOTES: a. For special conditions outside of user's control an extra allowance may be made up to 10% of the above figures.
b. For double-oven ranges extra allowance may be made to meet conditions up to 30% of the above figures.

RULE 7. The allowance for cooking and hot-water service shall be provided only for the number of months during the year in which the family occupy the premises.

RULE 8. Regardless of other rules, the amount allowed for heating or cooking, or hot-water service, shall not in any case be greater than the amount used for the year ending April 1, 1918, unless some valid reason is given which is satisfactory to the local Fuel Administrator.

RULE 9. These rules are based upon the use of stove-size in anthracite, or run-of-mine in bituminous for heating, and nut size or run-of-mine for cooking and hot-water service. The allowance for other sizes shall be an amount equal to the same total money value.

RULE 10. No allowance shall be made for the heating of garages or other outbuildings, excepting where absolutely necessary for the protection of food products or livestock.

RULE 11. It is contemplated by these rules that the coal used according to these rules will have a thermal value of 12,500 B. T. U. per pound. Adjustments may be made where coal has a lower thermal value.

NEW HEAT TRANSMISSION TABLES

A Remarkable Compilation of Factors as Given by Leading Authorities Covering Latest Types of Construction.

By **WILLIAM R. JONES,**
Superintendent, Department of Buildings and Grounds, University of Pennsylvania.

II

EDITOR'S NOTE.—*The first series of tables, published in the October issue, covered single window, double window, single skylight glass, double skylight glass, single window (wire glass), single window (double glass), single monitor glass, window glass wet, brick wall, brick wall (plastered one side), masonry wall with plaster, hollow fireproof tile wall (with plaster both sides), double fireproof tile wall (with plaster both sides—air space in center), brick wall (with hollow tile and cement mortar), hollow-brick wall (with brick furring, plastered on one side), concrete wall with sandstone facing, brick wall with sandstone facing, sandstone wall, sandstone wall (with 2-in. terra-cotta or wood furring and plaster), limestone wall and limestone wall (with 2-in. terra-cotta or wood furring or plaster).*

INDEX OF AUTHORITIES.

A—Average of various authorities to be used by the Department of Buildings and Grounds, University of Pennsylvania.

B—Alfred R. Wolff—Translation of requirements of the German Government—*Journal of the Franklin Institute*, Vol. 138, July, 1894, p. 45. Also Transactions American Society Heating and Ventilating Engineers—Vol. 3, 1897, p. 21.

C—Recknagel and Rietschel—Values interpolated by Kinealy. See "Formulas and Tables for Heating," 1899, p. 35. See also THE HEATING AND VENTILATING MAGAZINE, July, 1915, p. 21.

D—J. H. Kinealy—Construction used in this country but not in Germany. "Formulas and Tables for Heating," 1899, p. 35.

E—R. C. Carpenter—Translation from Péclet, "Heating and Ventilation of Buildings"—5th Edition, 1911.

F—B. F. Sturtevant Co.—Based on Wolff's figures. Catalogues No. 84 and No. 215 "Heating and Ventilation." (Slight variation from Wolff's figures.)

G—Austrian Government—Translated by W. W. Macon. Trans. A. S. H. & V. E., Vol. 14, 1908, p. 37. Also THE HEATING AND VENTILATING MAGAZINE, February, 1908 and July, 1915.

H—N. S. Thompson—"Mechanical Equipment of Federal Buildings," 1915.
  H-a—Federal Buildings, based upon figures of Prof. Homer Woodbridge.
  H-b—Factories or other buildings of inferior construction.

I—A. M. Greene, Jr.—"The Elements of Heating and Ventlation," 1913.

J—Buffalo Forge Co.—"Fan Engineering," 1914. Also catalogue No. 197, 1908.

K—Wm. G. Snow—"The Principles of Heating." 1912. Calculated from data published by Kinealy in "German Formulas and Tables for Heating and Ventilating Work." (Given for a 70° F. difference and when reduced to 1° F. difference do not check with other authorities.)

L—C. L. Hubbard—"Power—Heating and Ventilation." Vol. 2, 1914. Values given are for most thorough construction.
For ordinary well-built house add 10%
For fairly good construction add 20%
For poor construction 30%

M—J. M. Harrison—"Applied Heating and Ventilation," 1911.

N—J. R. Allen—"Notes on Heating and Ventilating," 1905. These values are based on those of the German Government.

O—James D. Hoffman—"Handbook for Heating and Ventilating Engineers," 1913.

P—Louis A. Harding—"Mechanical Equipment of Buildings," Vol. 1, 1916, "Heating and Ventilation," p. 59. Also "Design of Blower Heating Systems for Factory and Shop Buildings," 1915. "Heat Losses by Transmission Through Various Building Materials," Trans. A. S. H. & V. E., Vol. 19, 1913, p. 209.

Q—Carlton F. Tweed—THE HEATING AND VENTILATIN MAGAZINE, July, 1915. Also Power Plant Library.

R—National District Heating Association—Compiled by Prof. C. B. Veal, Bulletin January 15, 1916.

S—Practical Engineer.

T—American Radiator Co.—*Ideal Fitter*, May, 1916, p. 268.

U—Frank L. Busey—Transmission of Heat Through Building Materials. *Power*, April 21, 1914, p. 574.

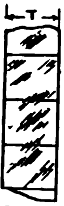
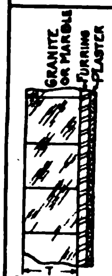
V—Prussian Government—required by—translation by Kinealy ot Recknagel's "Kalender für Gesunheit—Teckniker" for 1897. "Tables and Formulas for Heating."

W—THE HEATING AND VENTILATING MAGAZINE—"Standard Heating Data," February and March, 1917.

X—James A. Donnelly—"The Establishment of Standard Methods of Proportioning Direct Radiation and Standard Sizes of Steam and Return Mains." Trans. A. S. H. & V. E., Vol. 21, p. 529.

Y—Charles F. Hauss—Antwerp, Belgium. To figure heating work accurately. Constants obtained from practice of German engineer, Adolph Block, of Hamburg. Trans. A. S. H. & V. E., Vol. 10, 1904, p. 114.

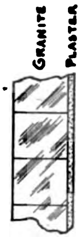
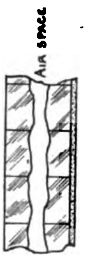
Z—E. N. Irwin—"Elements of Heating"—*Power*, Jan. 20, 1914, p. 89.

WALLS	THICKNESS T	USED BY U. OF PA. A	THOMPSON ONE WALL EXP. Ha	THOMPSON TWO WALLS EXP. Ha	GREENE I	IRWIN	NAT. DIST. HEATING ASSO. R	HUBBARD L	AMERICAN RADIATOR CO. T
 GRANITE OR MARBLE	8"								
	12"	.48	.480	.402	.54	.45			.440
	18"	.40	.408	.348	.45	.38		.34	.360
	21"	.37	.378	330		.35		.29	.307
	24"	.34	.354	.312	.39	.32		.27	.263
	27"	.32	.336	.294		GIVEN AS SOLID STONE		.24	.240
	30"	.30	318	.278	.34				
	33"	.28	300	264				.21	.214
	36"	.27	.282	252	.30			GIVEN AS SOLID STONE	.200
	40"	.26	.264	240					STONE = BRICK + 33⅓%
	48"	.24			.24				
 GRANITE WITH 2" TERRA COTTA OR WOOD FURRING AND PLASTER		A	HHa	HHa	II		RR		
	8"								
	12"	.40	.400	335	.28		.40		
	18"	.34	340	.290	.25		.34	.272	
	21"	.32	.315	275			32	.232	
	24"	.30	295	260	.23		30	.216	
	27"	.28	.280	.245			28	.192	
	30"	.27	.265	232	.21		27		
	33"	.25	.250	220			25	.168	
	36"	.24	.235	.210	.19		.24	80% OF UNFURRED WALL	
	40"	.22	.220	.200			.22		
	48"				.17				

Ha GRANITE WALL, FURRED AND PLASTERED + 20%

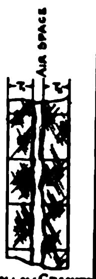
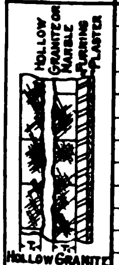
II-GIVEN AS MASONRY

E - CARPENTER GIVES STONE SAME AS BRICK

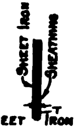
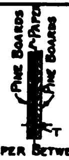
WALLS	THICKNESS T = T1 + T2	USED BY U. OF PA. A	THOMPSON 1 WALL EXPOSED Ha	THOMPSON 2 WALLS EXPOSED Ha			
 GRANITE OR MARBLE PLASTERED ONLY	12"	.46	.460	.385			
	18"	.38	.391	.334			
	21"	.36	.362	.316			
	24"	.33	.339	.299			
	27"	.31	.322	.282			
	30"	.29	.305	.267			
	33"	.27	.288	.253			
	36"	.26	.270	.242			
	40"	.25	.253	.230			
	48"	.23					
 HOLLOW GRANITE OR MARBLE PLASTERED ONLY		AA	HHa	HHa			
	12"	.35	.351	.282			
	18"	.31	.311	.247			
	21"	.29	.293	.232			
	24"	.28	.276	.219			
	27"	.26	.262	.207			
	30"	.25	.251	.198			
	33"	.24	.239	.189			
	36"	.23	.230	.181			
	40"	.22	.219	.171			

Ha – FURRED & PLASTERED GRANITE + 15%

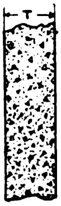
HHa – FURRED & PLASTERED HOLLOW GRANITE + 15%.

WALLS	THICKNESS T = T1 + T2	USED BY U. OF PA. A	THOMPSON ONE WALL EXP Ha	THOMPSON TWO WALLS EXP Ha	NAT. DIST. HEAT. ASSO. R	HUBBARD L	PECLET (CARPENTER) E	
 HOLLOW GRANITE OR MARBLE T = T1 + T2	8"						.30	
	12"	.37	.366	.294			.25	
	18"	.33	.324	.258		.289	.19	
	21"	.31	.306	.242		.246	.18	
	24"	.29	.288	.228		.229	.17	
	27"	.28	.274	.216		.204	.15	
	30"	.26	.262	.206		.179		
	33"	.25	.260	.197			.13	
	36"	.24	.240	.188		85% OF PLAIN WALL	.12	
	40"	.23	.228	.178			.10	
	-						.21	
 HOLLOW GRANITE OR MARBLE WITH 2" TERRA COTTA OR WOOD FURRING AND PLASTER T = T1 + T2	8"	A					GIVEN AS BRICK OR STONE WITH AIR SPACE	
	12"	.30	305	245	30			
	18"	.25	.270	215	.21	.231		
	21"	.23	.255	.202	20	.197		
	24"	.22	.240	190	.19	.184		
	27"	.21	.228	.180	.18	.163		
	30"	.20	.218	.172	.17	.143		
	33"	.19	.208	164	.16			
	36"	.18	.200	.157	.16	80% OF UNFURRED HOLLOW WALL		
	40"	.17	.190	149	.15			

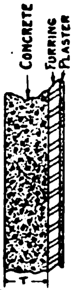
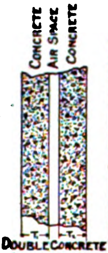
Ha HOLLOW GRANITE, FURRED AND PLASTERED + 20%
OR MARBLE, " " " + 20%

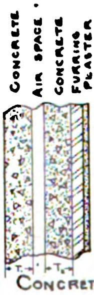
WALLS	THICKNESS T	USED BY U. OF PA. A	BUFFALO FORGE CO. J	HUBBARD L	AMERICAN RAD. CO. (BRICK + 20%) T	BUSEY U		
REINFORCED CONCRETE	4"	.80		.80	.816			
	8"	.63		.55	.552			
	12"	.48		.40	.396			
	16"	.41			.324			
	20"	.36			.276			
	24"	.31			.240			
	28"	.28			.216			
	32"	.26			.192			
	36"	.24			.180			
 SHEET IRON ON PINE BOARD SHEATHING	½"	.50	.50			.50		
	1"	.40	.40			.40		
	1½"	.33	.33			.33		
	2"	.28	.28			.28		
	2½"	.25	.25			.25		
 PAPER BETWEEN PINE BOARDS	½"	.32	.32			.32		
	1"	.24	.24			.24		
	1½"	.19	.19			.19		
	2"	.16	.16			.16		
	2½"	.14	.14			.14		

L- WHEN FURRED & PLASTERED TAKE 80% OF ABOVE VALUES
- WHEN HOLLOW, UNPLASTERED TAKE 85% " " "

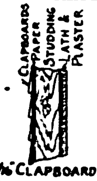
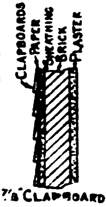
Walls	Thickness T	Used by U. of Pa. A	Austrian Gov. (Macon) G	Thompson Hb	Thompson Ha	Buffalo Forge Co. Brick + 20% J	Hubbard L	Harrison K		American Rad. Co. Brick + 50% T	H & V Magazine 1917— W	Greene I	Donnelly X	Irwin Z	Busey U
 Plain Concrete	2"			.87$^{\triangle}$										.85	
	4"	.90		.69$^{\triangle}$		.684		.56		1.020	1.07		1.07	.785	
	6"	.77		.59$^{\triangle}$							0.70		.714	.56	
	8"	.63	.49	.49		.444	.66	.41		.690	0.51		.527	.49	.463
	10"	.56		.44$^{\triangle}$										.42	
	12"	.48	.43	.54$^{\triangle}$	.540	.348	.48	.31		.495	0.43	.48	.357	.37	.363
	16"	.41	.37	.37	.468		.39			.405	0.36		.257		.313
	18"	.38				.300						.38			
	20"	.35	.33	.33	.420	.264				.345					.275
	24"	.31	.30	.30	.372					.300		.31			Brick + 25%
	28"	.28	.27	.27	.336	.228				.270					
	30"	.27										.27			
	32"	.26	.25	.25	.312					.240					
	36"	.24	.23	.23	.288					.225		.24			
	40"	.22	.22		.264							48" .19			
 Concrete Plastered One Side		AA	Does not state whether plastered or not. Probably plastered.		HHa	JJ				Given as Brick + 50%	WW Concrete with Sandstone Facing				UU
	4"	.82				.600									
	8"	.59				.432									.450
	12"	.46			.518	.336					.45				.350
	16"	.39			.449	.288					.39				.300
	20"	.33			.403	.252					.35				.263
	24"	.29			.357						.31				
	28"	.27			.322	.216					.28				
	32"	.25			.299						.26				
	36"	.23			.276										
	40"	.21			.253										

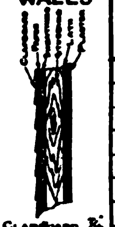
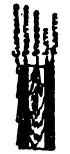
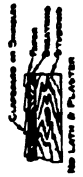
Ha — Furred and Plastered Concrete + 20%
HHa — " " " + 15%
Hb { Ascribed by Macon to Reitschel and for ordinary construction have been increased 25%. (Above figures have been increased)

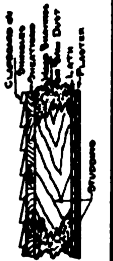
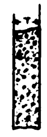
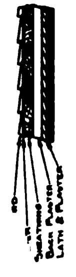
Walls	Thickness T = T₁ + T₂	Used by U. of Pa. A	Thompson Ha	Greene I	Busey U	Nat. Dist. Heat. Asso. R	Austrian Gov. (Macon) G	Hubbard L	Buffalo Forge J
 Concrete with 2" Terra Cotta or Wood Furring and Plaster	8"	.63			.29			.528	.276
	12"	.40	.45	.26	.25	.47		.384	.240
	16"	.34	.39			.41		312	
	18"	.31		.24	.23			60% of Plain Concrete	.216
	20"	.29	.35		.20	.37			.192
	24"	.26	.31	.21		.33			Brick + 20%
	28"	.24	.28			.30			
	30"	.23		.19			Does not state whether plastered or not. Probably plastered.		
	32"	.22	.26						
	33"	.22				.28			
	36"	.20	.24	.17		.26			
	40"	.18	.22			.24			
	44"	.17				.20			
	48"	.16		.15					
	4"	.72							.336
 Double Concrete Wall with Air Space T = T₁ + T₂	8"	.48					.30	.561	.300
	12"	.37					.28	.408	.252
	16"	.33					.26	.331	.228
	20"	.29					.24	85% of Plain Concrete	.192
	24"	.26					.22		
	28"	.24					.20		.168
	32"	.22					.19		
	36"	.20					.18		
	40"	.18					.17		

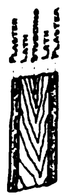
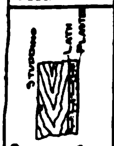
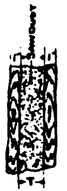
Walls	Thickness T	Used at U of Pa. A	Busey U	Hubbard L
 Concrete with Air Space, Furred & Plastered. T = T₁ + T₂	8"	.38	.313	.449
	12"	.30	.263	.326
	16"	.25	.238	.265
	20"	.20	.200	
	24"	.19		80% Value for Unfurred Hollow Wall
	28"	.18		
	32"	.18		
	36"	.17		

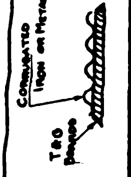
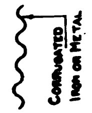
WOODEN WALLS	THICKNESS T	A USED BY U. OF PA.	B GERMAN GOV. (WOLFF)	E PECLET CARPENTER	G AUSTRIAN GOV. (MACON)		I GREENE 1918.	J BUFFALO FORGE CO.	K SNOW			R NAT. DIST. HEATING ASSO.	T AMERICAN RAD. CO.	U BUSEY	RECKNAGEL & RIETSCHEL				P HARDING	Z IRWIN
															PINE		OAK			
															INNER C	OUTER C	INNER C	OUTER C		
WOOD	⅜	.86		GIVEN AS SOLID WOOD. NOT APPLICABLE TO WOODEN BLDGS. ONLY USED TO CHECK CALC.	.56							.56								.29
	½	.78			.62			.77				.52		.77	.52	.56	.64	.70		FRAME HOUSE CONSTRUCTION. THICKNESS NOT GIVEN
	¾	.69			.44	27	.55					.44			.44	.47	.59	63		
	1	.59	.41		.41	24	.48	.51				.41		.61	.39	.41	54	.58	1" .547	
	1½	.51				21	.40	.43	.30					.43	.31	.32	.47	.50	1½" .370	
	2	.43				GIVEN AS WOOD PLASTERED BOTH SIDES.	.34	.35	.257			.28		.35	.26	.27	.41	.43		
	2½	.39						.30	.228			GIVEN AS PINE BOARDS		.30	.22	.23	37	.39	2½" .279	
	3	.36						GIVEN AS PINE BOARDS	.20					GIVEN AS PINE BOARDS	.19	.20	.33	.35	GIVEN AS SOLID WOOD PARTITION	
	3½	.32							GIVEN AS PINE BOARDS											
	4	.29		.120																•.24
	8	.17		.065																•.46
	12	.13		.045																BOTH VALUES FOR FACTORY BLDG. FLOORS. THICKNESS NOT GIVEN
	16	.10		.033									WOOD WALL. THICKNESS NOT GIVEN							
	18	.09		.031	INTERIOR PARTITIONS															
	20	.08		.030																
	24	.07		.029																
	28	.06		.027																
	32	.05		.025																
	36	.05		.020																
	40	.04		.018																
	1½"	.55											.22		1½" .34	1½" .36	1½" .50	1½" .54		

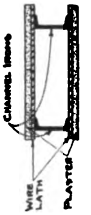
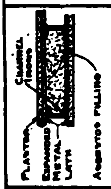
FRAME WALLS	THICKNESS	A USED BY U. OF PA.	D KINEALY	H THOMPSON	J BUFFALO FORGE CO	L HUBBARD	N ALLEN	O HOFFMAN	P HARDING	Q TWEED	R NAT DIST HEATING ASSO.	I GREENE 1913	W H & V. MAGAZINE 1917—	X DONNELLY	Z IRWIN			
7/16" CLAPBOARDS, STUDDING, LATH & PLASTER.		.45	.44	.44	.44	.30	.1	.25 to	.47	.25	.45		.44	.471	.29			
								.30							FRAME HOUSE CONSTRUCTION			
	WITHOUT L & P	.48											.47					
	FACTORY BLDGS														24 to			
	FACTORY BLDGS														46			
 7/16" CLAPBOARDS, PAPER, STUDDING, LATH & PLASTER.		AA	DD	HH	JJ	LL	NN	OO	PP	QQ	RR	II	WW	XX				
		.31	.31	.31	.31	.30	.1	.25 to	.34		.31		.31	.343				
						FOR WALLS OF THE AVERAGE WOOD DWELLING	FOR ORDINARY WOOD HOUSE CONSTRUCTION	30										
	WITHOUT L & P	.34						FOR WALLS OF THE AVERAGE WOOD DWELLING					.34					
 7/8" CLAPBOARDS, PAPER SHEATHING, BRICK & PLASTER		AAA				LLL	NNN	OOO	PPP	QQQ		III	WWW					
		.30				.30	.1	.25 to	.21	.25		.20						
								30					.22					
													CLAPBOARDS, BRICK LINED & PLASTERED					

FRAME WALLS	THICKNESS	A USED BY U. OF PA.	D KINEALY	H THOMPSON	I GREENE 1913	J BUFFALO FORGE CO.	K SNOW	L HUBBARD	N ALLEN	O HOFFMAN	P HARDING	R NAT. DIST. HEATING ASSO	T AMERICAN RAD. CO.	W H&V MAGAZINE 1917–	X DONNELLY			
 CLAPBOARD ⅞" PAPER, SHEATHING ⅞" STUDDING, PLASTER & LATH.		.24	23	23	.20	23	.228	.30	J	25-30	.20	.24		.23	.257			
								FOR WALLS OF THE AVERAGE WOOD DWELLINGS	FOR ORDINARY WOOD HOUSE CONSTRUCTION	THE WALLS OF THE AVERAGE WOOD DWELLING	GIVEN AS WOODEN WALL OR FLOOR							
 CLAPBOARD ⅞" SHEATHING ⅞", LATH STUDDING & PLASTER		AA	DD	HHa	II	JJ	KK	LL	NN	OO	PP	RR	TT	WW	XX			
		.29	.28	.28		.28	.286	.30	J	25-30	.30	.29	.280	.27	.30			
	WITHOUT L.&P.													.30				
		AAA			III							RRR		WWW				
		.29			.31							.27		.26				

WALLS	THICKNESS T	A USED BY U. OF PA.	V PRUSSIAN GOV. RECHNAGEL	D KINEALY	I GREENE	L HUBBARD	O HOFFMAN	Q TWEED	R NAT. DIST. HEATING ASSO	W H&V MAGAZINE 1917–	Y HAUSS GER. PRACTICE	G AUSTRIAN GOV (MACON)	X DONNELLY					
		.10			.08			.10										
 PLASTER		AA	VV			LL	OO	QQ	RR	WW	YY	GG						
	[illegible]	.61	.815							WIRE LATH, CEMENT & PLASTER	.60	1½" .62						
	[illegible]	.52	.492								.48	2" .59						
	2"	.60				.60	.60	.60	.60			2½" .56						
	3"	.50				.50	.50	.50	.50			3" .53						
												3½" .50						
	1½"-2½"	.61								.61		4" .47						
	3"-3½"	50								.49								
		AAA							RRR				XXX					
		.21							21				.214					

WALLS	Thickness T	A Used at U of Pa	D Kinealy	H₀ Thompson	I Greene 1913	J Buffalo Forge Co.	K Snow	O Hoffman	Q Tweed	R Nat. Dist. Heat. Asso.	W H&V Magazine 1917	X Donnelly
 Ordinary Stud Partition Plaster both Sides.		.34	.34	.34	.36	.34	.143	.34	.34	.34	.34	.30
										4" Studs		Given as partition between heated and unheated room.
 Ordinary Stud Partition Plaster on one Side.		AA	DD	HH₀	II	JJ	KK	OO	QQ	RR	WW	XX
		.62	.60	.60	.49	.60	.257	..6	.49	.54	.60	.60
										4" Studs		
 Double 1" Board with Sawdust between.	Saw Dust	AAA				JJJ						
	2"	.13				.127						
	4"	.09				.083						
	6"	.06				.062						
	8"	.05				.049						

WALLS	Thickness	A Used at U. of Pa.	H♭ Thompson	J Buffalo Forge Co.	L Hubbard	T American Rad. Co.	W H&V Magazine 1917	U Busey
 Corrugated Iron or Metal Lined with T&G Boards			.17					
	½"	.45		.45				.45
	1"	.36		.36				.36
	1½"	.30		.30				.30
	2"	.26		.26				.26
	2½"	.23		.23				.23
 Unlined Corrugated Iron or Metal		AA	HH♭	JJ	LL	TT	WW	
		1.50	.84	1.50	1.20	.840	.84	
 Sheet Iron Siding Unlined		AAA		JJJ				
		1.20		1.20				

WALLS	Thickness	A Used at U. of Pa.	I Greene 1913	Q Tweed	R Nat. Dist. Heat. Asso.
 		.34	.34		.34
 Channel Irons Plaster Expanded Metal Lath Asbestos Filling		AA	II	QQ	RR
		.21	.21	.21	.21
		AAA			

CHICAGO COMMISSION ON VENTILATION

A VENTILATION PARADOX

The Use of Air From Chicago's Freight Tunnel as a Refrigerating Agent and Fuel Conserver.

By **THOMAS R. WILSON,**
Ventilation Engineer, Chicago Health Department.

(Concluded from October issue.)

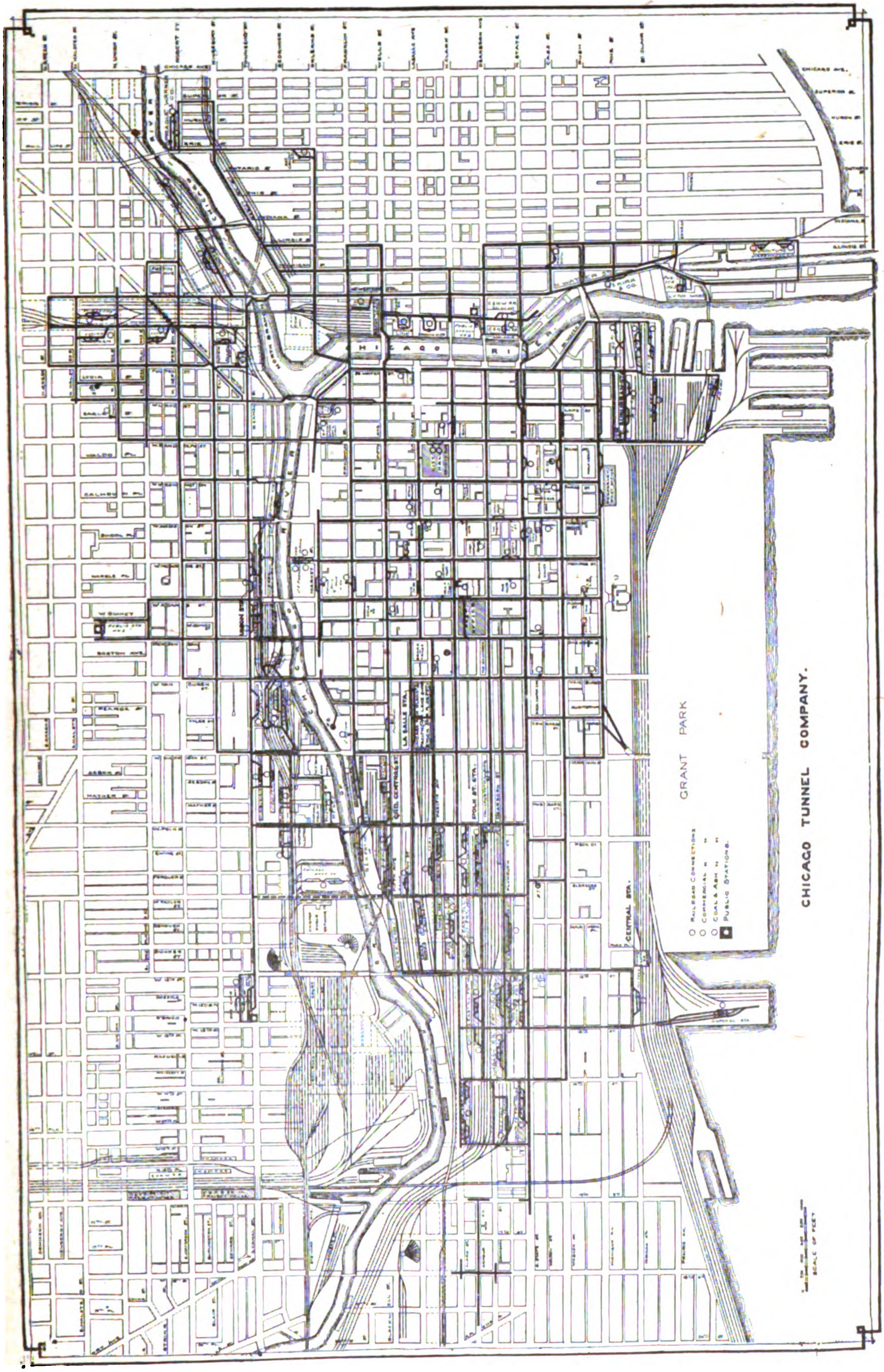
POSSIBILITIES IN USE OF TUNNEL AIR FOR COOLING PURPOSES.

The writer believes the first to recognize the dormant possibilities in the use of tunnel air for cooling purposes was the proprietor of a large caféteria located in the basement of one of our commercial buildings. The restaurant in question has a 36-in. direct-connected disc fan drawing air through a 36-in. connection from the tunnel crown. The air is delivered by the fan into a plenum space between the street retaining wall and the metal lath and plaster wall of the restaurant. This plenum space extends along two sides of the dining-room. The supply registers are located near the ceiling line in these walls. The intake is so arranged that if the restaurant becomes too cold the tunnel air may be tempered by a judicious admixture with air from out-of-doors.

TEMPERATURE DIFFERENCE MAY BECOME TOO GREAT FOR COMFORT.

The proprietor states that the adoption of the cooling system changed the restaurant from a losing proposition to a comfortable money-making eating place. He asserts further that the equipment will maintain a 65° temperature in the dining room when the temperature outside is 95°. It is the writer's opinion, however, that this difference is too great to be compatible with comfort. A temperature ranging about 75° when the outside temperature is 85°, or 85° when the outside temperature is 105°, is a sufficient contrast for comfort and still does not give the impression of chill that a 30° difference would produce, especially during the first 15 or 20 minutes after entering the room. In other words, with too great a temperature difference the delicate mechanism which regulates heat transmission from the body is suddenly burdened by the additional work of adjusting itself to a new, highly-contrasted condition, subjecting the person possibly to an even greater degree of discomfort than would be experienced from excessive heat.

During the summer months of 1916 this subject attracted the attention of some of the larger theatre owners in the city. Theatre patrons object to sitting through a performance on a hot night with a temperature of 90° and a high relative humidity in the auditorium, consequently the theatre business is a losing proposition during the summer months and many amusement houses are closed for this reason. The expense of installing a refrigerating equipment is frequently out of proportion to the benefits derived when we consider the comparatively short duration of the hot season. If tunnel air at practically no expense could be used for cooling these theatres it would be a



MAP OF CHICAGO'S FREIGHT TUNNEL SYSTEM.

happy solution of the problem. The question at once arose whether this was reasonable and whether or not the tunnel air was detrimental to health or objectionable on account of odors or for any other reasons. The Ventilation Division was, therefore, requested to make an investigation of this matter and to decide whether or not the tunnel air could be used for this purpose. Air tests were made in the tunnel itself at three different locations, the results of which were as follows:

CO_2—3.5—3.5—4.0—3.5—3.2—3.2—3.4
Bacteria—2—7—14—3—6 colonies, 2-minute plate
Dry Bulb—53—53—52° F.
Wet Bulb—45—46—45° F.
Dust—10,600—14,000—12,000—9,600

These tests, in connection with the others previously reported, and with the careful inspection of conditions in the tunnel justify the following conclusions:

1st—Tunnel Sanitation: The tunnel is maintained in accordance with the best sanitary requirements. The company enforce reasonable sanitary rules and regulations most rigidly. The numerous shafts and building connections provide suitable egress to toilet facilities. During the numerous inspections made in the tunnel, no insanitary conditions were observed.

2d—Dust: Numerous samples of the air have been taken to determine the dust content. The highest count obtained was 15,000 particles per cubic foot. This was during cold weather when the moisture content of the air was at its lowest point, (53° dry—45° wet). Furthermore, these samples were taken under most adverse conditions, several trains having just passed previous to the collection of the samples.

3rd—Bacteria: Of the numerous culture plates exposed the highest colony count was 14. This was taken at the time of the dust sample, just after trains had passed the observing station. Many plates were exposed which developed no colonies. The average for all plates was 2. These plates show a very low bacterial content when compared with others exposed in the open air.

4th—Odors: The percentage of odors was always low and typical of tunnel air. They disappeared almost entirely after heating some 20° or 30°.

5th—CO_2: Of the samples of air analyzed the CO_2 gave a content of 3.5 or less, with one exception. The exception was taken at a point where contamination was possible from a boiler-room connection. The analysis of this sample was 4.5.

6th—Temperature—Dry-Bulb: The dry-bulb temperature ranges from 47° in cold weather to 57° during the summer months.

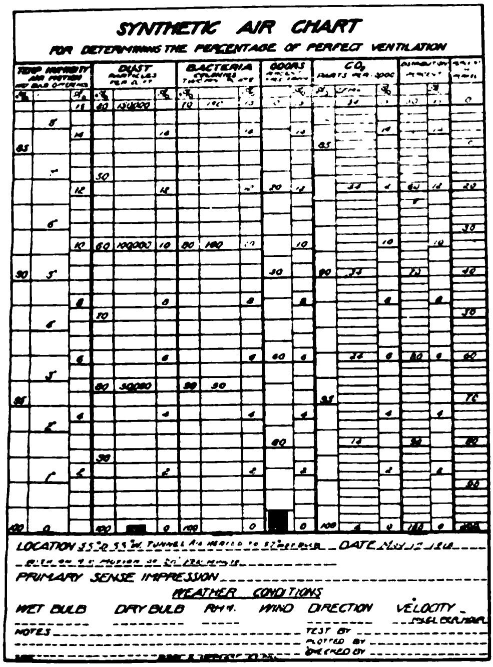
7th—Temperature—Wet-Bulb: The wet-bulb readings range from 57° in the summer or a total saturation to a maximum depression of 8° in cold weather. The extent of the depression is determined almost entirely by the moisture content of the outside air.

TUNNEL AIR TEST RESULTS SHOWN ON SYNTHETIC AIR CHARTS.

The average results of these tests are computed on the synthetic air charts shown herewith. The results are calulated on warming the tunnel air to a wet-bulb of 57°, which is the desirable wet-bulb for an air motion of 20 ft. per minute. As the wet-bulb temperature of the tunnel is always lower than this point, it is essential that some heat be added to bring the air to the desirable temperature necessary for comfort. It is only necessary to add a small amount of heat to raise this air to the comfortable wetbulb temperature.

Studying the foregoing test and the summary of the same it is reasonable to conclude that the air from the tunnel can be used with safety for the purposes desired. It has a lower dust, bacterial and CO_2 content than the air from above ground, contains more moisture and is free from objectionable odors when warmed to the temperature necessary for comfort.

During a tour of inspection through



LOCATION [illegible] TUNNEL [illegible] DATE [illegible]

[illegible]

PRIMARY SENSE IMPRESSION

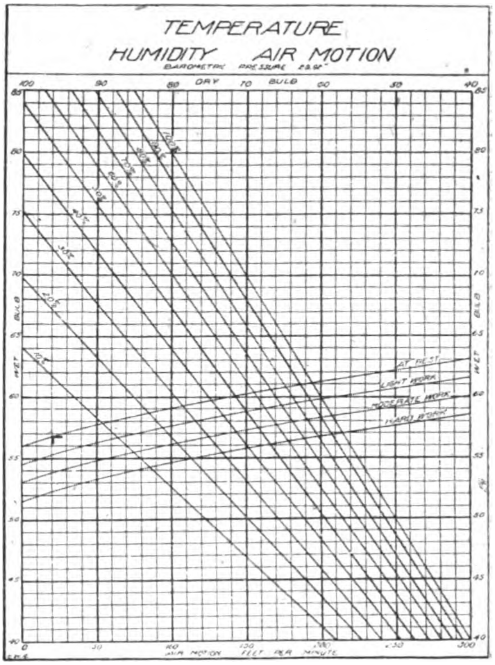
WEATHER CONDITIONS

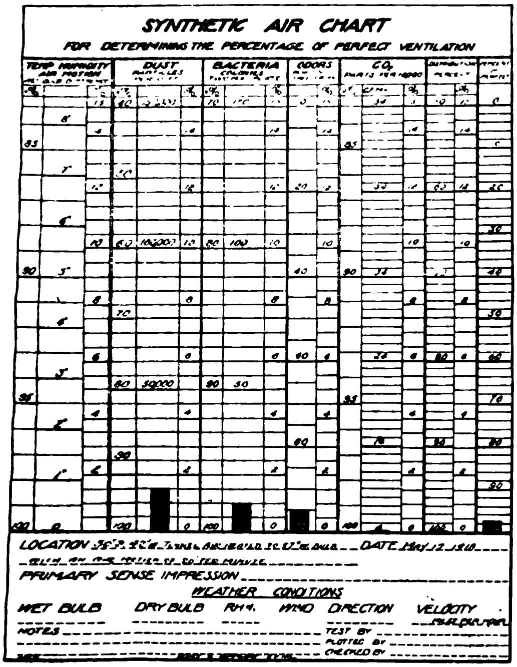
WET BULB DRY BULB RH%. WIND DIRECTION VELOCITY [illegible]

NOTES TEST BY

PLOTTED BY

CHECKED BY





LOCATION [illegible] DATE [illegible]

[illegible]

PRIMARY SENSE IMPRESSION

WEATHER CONDITIONS

WET BULB DRY BULB RH%. WIND DIRECTION VELOCITY [illegible]

NOTES TEST BY

PLOTTED BY

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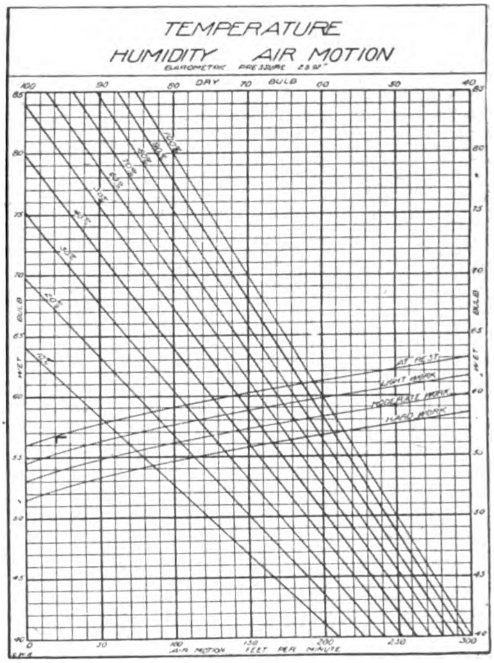

RESULTS OF TESTS OF TUNNEL AIR SHOWING ITS ADAPTABILITY FOR USE IN COOLING THEATRES.

the tunnel many employees were questioned by the Commissioner of Health regarding their health and the prevalence of disease among their fellow workmen. Their answers were uniformly favorable and their general appearance and physical condition were certainly above the average of indoor workers above ground.

CALCULATION OF ADVANTAGES SECURED IN USING TUNNEL AIR FOR THEATRE VENTILATION.

The reader is willing to allow that the test and investigation previously referred to show in results that the tunnel air is equal, in purity, if not better than the outside air. Then the question arises what are the benefits to be derived from the use of tunnel air for ventilation purposes during the winter and summer months? Let us take, as a concrete illustration, a theatre 150 ft. long, 100 ft. wide and 50 ft. high, seating 1,000 people, the walls and roof having an average heat transmission coefficient of 0.5 B. T. U. per square foot per degree difference per hour, with a 95° temperature outdoors and maintaining an 80° temperature inside. A temperature of 80° is selected because of the sufficiency in temperature contrast, the reasons for which are explained in an earlier part of this article. Our problem is to determine the volume of 55° air necessary to maintain an 80° temperature in the theatre.

We have to contend with three factors which would tend to operate against this 15° drop from outdoor temperature:

1.—Heat infiltration through the walls and roof.
2.—Heat generated by the occupants.
3.—Miscellaneous sources of heat, such as from lights, motors, etc.

This theatre has a total exposed area, including walls and roof, of 4,000 sq. ft. of surface. This exposed surface times our heat transmission coefficient factor of 0.5 would permit 20,000 B. T. U. heat infiltration per degree difference in temperature per hour, and with a 15° drop in temperature this amount of heat infiltration would equal 300,000 B. T. U. per hour. Next to consider would be the heat given off by the occupants. Various authorities give 400 B. T. U. per hour per person as an average heat loss and this heat loss, multiplied by 1,000 occupants, would equal 400,000 B. T. U. per hour. Estimating 50,000 B. T. U. per hour from the miscellaneous sources of heat we have a total of 750,000 B. T. U. per hour which we must offset with a certain volume of cool air sufficient to maintain a final temperature of 80°. From our formula, C. F. M. times weight of air, times specific heat, times temperature difference, times minutes, we have the equation:

$$\text{C. F. M.} = \frac{750{,}000}{0.074 \times 0.241 \times 60 \times 25} = 26{,}800 \text{ C. F. M.}$$

which is the volume of entering air at 55° necessary to maintain an 80° temperature in the theatre.

The foregoing example, together with the results previously given of the analyses and tests of air purity and properties, give determinations that in the initial cost of construction, renewals and repairs, purity of air supply, relative freedom from dust and bacteria, improvement in humidity conditions, and in the fact that restaurant odors, smoke or any of the allied nuisances cannot enter the intake, should make this method of summer ventilation a very desirable one for those who are in need of and in locations to avail themselves of this unique method of achieving the desired result.

COMPARATIVE FIGURES, USING OUTSIDE AIR.

Let us consider what would have happened had the same volume of outside air been used in this theatre for ventilation. We would have had to start with a 95° temperature in the building and to this would be added a certain temperature rise, which we will determine, this addition being due to the 400,000 B. T. U. per hour given off by the occupants and to the 50,000 B. T. U. given off by the miscellaneous sources of heat, equalling 450,000 B. T. U. per hour which would have to be dispersed. This would be accomplished in two ways, first by heat loss through the wall, and second by warming the air to some certain temperature above 95°.

Our problem now is to be determine the temperature in the theatre under these conditions, that is, to find out the temperature rise above 95° at which the heat necessary to raise the air temperature and the heat loss through the walls will utilize our available 450,000 B.T.U. per hour or 7,500 B. T. U. per minute. With our formula we find that 26,800 C. F. M. x 0.241 x 0.074 x 1° = 480 B. T. U. are required per minute to raise 26,800 C. F. M. 1°. Our heat loss through the wall per degree difference per minute is

$$\frac{40{,}000 \text{ sq. ft. x } 0.5}{60} = 333 \text{ B. T. U.},$$

so that with each one degree rise in temperature, with this volume of air, we will utilize 813 B. T. U. per minute. 813 B. T. U. per minute is the sum of our wall losses and heat necessary to raise 26,800 C. F. M. 1°, and as we have 7,500 B. T. U. per minute available in heat generated in the building it is apparent that

$$\frac{7{,}500 \text{ B. T. U.}}{813}$$ will give the required

temperature rise necessary to utilize the heat generated in the building, or 9¼°. This is 9¼°, plus our original temperature of 95° gives a resultant temperature of 104¼°, quite a contrast from our final temperature of 80° obtained by the use of the tunnel air.

SAVING IN FUEL WITH TUNNEL AIR.

With the use of tunnel air in winter a further benefit is to be derived, namely the saving in fuel, and with the adverse conditions which made the coal problem last winter one of public concern it is not to be wondered at that those who are using this air for heating are enabled to cut their coal bills to an appreciable extent.

In Chicago the average temperature for the heating season is 31° F., so it may be easily determined that by the use of this 50° tunnel air in comparison with our 31° outdoor air just what fuel saving would be effected. In using outside air for tempering to 70° we must supply sufficient heat to raise the temperature 39°, while with the use of tunnel air we require a sufficient amount of heat to raise the temperature only 20°. This saving in heat amounts to 19/39 or about 49%. In blast heating a saving is accomplished but to a less extent, due to the final temperature being 100° instead of 70°. The saving in coal with this method of heating amounts to 19/69 or about 27½%. In the foregoing calculations the moisture content has been neglected.

The fuel-saving factor in using tunnel air in cold weather; the marked cooling effect in warm weather, together with its non-injurious properties, as found by test and proven by the physical condition of the tunnel employees, make it deserving of the recognition which it is now receiving. To the writer's knowledge there are at the present time three theatres, two restaurants and a number of boiler- and engine-rooms using this air for ventilation purposes. Several other theatres have this project under consideration and it is possible that this number will be increased in the near future. It may well be said that in using tunnel air for ventilation purposes we are making a saving instead of burning at both ends of the candle.

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A. S. ARMAGNAC....................*President*
GUSTAVE PETERSEN....*Secretary and Treasurer*

A. S. ARMAGNAC, Editor
GUSTAVE PETERSEN, Business Manager
HAROLD L. ALT, Contributing Editor

European Representative:
W. G. HOLLINWORTH, 304 High Holborn
London, W. C.

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"THERE must have been something wrong with our copy in your last issue," writes one, of our advertisers, "as we received only two inquiries." We have no hesitation in publishing this comment because it brings up a question of what really happens when publicity is given through the columns of an engineering journal to a manufacturer's product. In this particular case the device in question is comparatively new. Its application is a distinct departure from the usual practice. What, then, may the manufacturer of such a device expect from an initial campaign of publicity?

We know that the average man reads the advertising, as well as the reading pages, of his magazine. He sees the familiar names of the various manufacturers in his field and his attention, no doubt, is arrested here and there by some announcement of a new development or a change of model in familiar types of apparatus. Presently he comes upon the announcement of something entirely new and distinct. The chances are he will stop here and read what the announcement says. What is his attitude of mind as he does this? Is there not usually a note of skepticism as to whether the device will successfully fulfill the claims made for it? We are speaking now of the average reader. Does he not say to himself, "Another new wrinkle. Well, what's the matter with the way we have always been doing it?" Or else, he may admit to himself that the method looks feasible. Some day, he thinks, he will try it out but not until he has seen it in operation or has heard from others what it will do.

Does this mean that the publicity given the device has been in vain? We think not. The repetition of the announcement again catches his eye. If the manufacturer is wise he will present before long some figures showing actual performance or refer to some typical installations that have been successful. Finally our average reader decides that he wants to keep up with the latest developments and writes in for data or a catalogue. The rest depends upon the merits of the device itself.

We do not think the foregoing is peculiar to the heating trade, by any means. The heating trade has often been accused of being a close corporation in which the newcomer finds it a hard matter to drive an opening wedge. This, however, is human nature. Why should engineers be in a hurry to take up with each new device as it appears when they know those they are using are reliable, at least?

The function of the trade journal is to bring the new developments to their attention, the function of the advertiser, as we take it, is to keep attention focussed on his product irrespective of the number of inquiries he receives. This done, the function of the reader will take care of itself, for no desirable customer is going to deprive himself for long of the advantages of a really useful improvement that can be applied in his practice.

NO QUARREL NECESSARY BETWEEN NATURAL AND MECHANICAL VENTILATION ADVOCATES

Clear and Well-Defined Field for Each Method Depending Upon Required Air Conditions with Given Type of Occupancy and Occupation.

A timely contribution to the discussion of open-window versus mechanical ventilation is made by Dr. E. Vernon Hill, head of the Division of Ventilation of the Chicago Department of Health. It seems that an article was published recently in "The Ways of Health" Department of the *Chicago Daily News* entitled "Open Windows vs. Fans," to which Dr. Hill made a vigorous reply, the principal portions of which are given herewith:

"Many persons, social workers, physicians, and I am sorry to say, public officials, enjoy declaiming about ventilation, the open window, God's fresh air, etc., laying undue emphasis upon the methods employed to ventilate a room with little or no thought as to the actual conditions maintained therein. They usually proclaim the virtue of natural methods as against the artificial or mechanical.

"We must admit, however, that these misinformed michief-making enthusiasts for fresh air are not the only ones at fault. Strong partisanship is also exhibited on the other side of the fence. Heating and ventilating contractors, and, to a less extent, manufacturers of equipment, are not slow to defend mechanical ventilation. Their defense unfortunately is not always confined to the well-designed and efficiently-operated equipment but takes in everything that goes by the name of a mechancal equipment. Many of them would advocate permanently closing the numerous windows of the cathedral of St. Peter in Rome and installing some ducts, a fan and a stack of Vento, confident that in this manner they would improve air conditions in this historic edifice. This is all entirely wrong. It is not only unscientific but tends to block progress in one of the most important fields of preventive medicine.

NATURAL VENTILATION LIKENED TO INDIVIDUAL WATER SUPPLY.

"There is no quarrel between natural and mechanical ventilation any more than there is between natural and a mechanical water supply for the City of Chicago. There was a time when a man could go out into his backyard and dig a well and get a pure and abundant supply of clean water for his household use. That time has long since passed in large cities, and we must now have recourse to a mechanical water supply. In some cases we must go further than this, we must filter it, chlorinate it or otherwise treat it to make it pure and wholesome, and anyone who is so ill-advised as to condemn the latter method and to recommend going back to the old well in the yard would be the laughing stock of the community.

"The situation is parallel with that of our ventilation problem. There are many places and conditions, in rural districts particularly, where natural ventilation meets all the requirements and where it is folly to install fans or other mechanical devices. There are some rooms, even class-rooms, where the space per occupant is ample; where the window area is adequate; where the outside air is uncontaminated and where noise on the outside of the building is not excessive in which window ventilation is entirely satisfactory. There are many other locations, however, at the present time, and the conditions producing them are unfortunately increasing, where natural ventilation is entirely out of the question and where we must, therefore, have recourse to mechanical methods, not from choice but from necessity.

"Saxon Snell, the well-known English authority, in speaking of the ventilation of churches hits the nail squarely on the head when he says 'I do not say that mechanical ventilation is not necessary and desirable in many instances, but I do say that no church should be constructed that requires it.' This is true not only of churches but of a considerable number of other buildings. Factories, where the process carried on does not contaminate the air; where the space per occupant is 1000 cu. ft. or more, and where the windows are situated on four sides of the room, which is undivided by partitions, do not require mechanical ventilation. This has been amply proven by the tests conducted by the Chicago Commission on Ventilation in the Paris Garter Factory and other similar buildings in the city. Offices with somewhat less space per occupant and practically the same ratio of window area do not require mechanical ventilation. In many buildings of this type, however, the space per occupant is insufficient or the necessary window area cannot be obtained. Again, the space may be divided by partitions that prevent air circulation. In this case, as in many others which we will not discuss at the present time, adequate ventilation by means of window becomes impossible and we must adopt mechanical means.

"Let us have done, therefore, with this foolish and unprofitable argument respecting the comparative values of mechanical vs. natural ventilation. Let us understand that each has its clear and well-defined field and that our problem is not to determine their relative value but rather to determine what air conditions are desirable in a given space with a given type of occupancy, occupation, etc., and then to decide from experience and from tests in similar buildings whether these conditions can be maintained without mechanical ventilation. If they can, let us by all means make use of natural methods; if they cannot, let us adopt whatever mechanical adjuncts are necessary to obtain the desired results.

"There is no mystery in the science of ventilation at the present time. The brilliant work of modern investigators has placed the subject on a logical, scientific basis, leaving little room for the timeworn prejudice or personal opinion. The factors that influence or control air conditions are fairly well understood. They are the temperature, humidity and air motion; the dust, bacteria and CO_2 content, and the degree of objectionable odors present. Air distribution also, although not strictly speaking a factor, should be given due consideration when we are dealing with air conditions in a confined, occupied space.

"It is possible to design a record card on which each of these factors is given its proper weight and importance as a part of the whole and to plot test results on this card from actual observation made in a given room. From this record we can now determine the percentage of perfect ventilation as shown by our test, and, what is of equal importance, we can see in what respect it is deficient. I enclose such a card for your information showing a test in a school classroom ventilated by windows only. I will say by way of explanation that with a complete, intelligently designed mechanical system we expect to obtain a percentage of not less than 95 in a class-room in winter weather with the windows closed. The test record submitted shows a percentage of 88. Equipped with this device, this ventilation measuring stick as it were, the investigator can compare results of different tests on a cold mathematical basis, necessarily excluding private opinion and prejudice.

"Many hundreds of tests of this kind in school class-rooms ventilated by windows and by mechanical systems, in theatres, factories, offices, workshops and other public, semi-public and private buildings have been made by the Ventilation Division of the Chicago Health Department since its organization in June, 1912. From the observations and experiences thus gained, and from an analysis of our records, certain conclusions are unavoidable. The following may be of interest:

CONCLUSION OF CHICAGO DIVISION OF VENTILATION.

"1.—Natural ventilation by means of windows is satisfactory in offices, light manufacturing industries, etc., where the work done or the process carried on does not materially contaminate the air, provided:

(a) A minimum of 900 to 1000 cu. ft. of space per occupant is available.

(b) Windows are provided on four sides of the space having an area from 10% to 12% of the floor area.

(c) Humidifying devices are installed that will maintain a wet-bulb temperature of not less than 57°.

(d) Thorough cleanliness with respect to the floors, furniture and general equipment is maintained.

"2.—Natural ventilation by means of windows is possible in school class-rooms, provided:

(a) The space per occupant is not less than 800 cu. ft.

(b) The window area must not be less than 12% of the floor area, windows on at least two opposite sides of the room.

(c) Artificial humidifying devices capable of maintaining a wet-bulb of 57° in cold weather, with air circulating fans to equally distribute the moisture and maintain a satisfactory air movement throughout the room.

(d) Oiled floors and scrupulous cleanliness must be observed.

"3.—Patent window ventilators, cloth screens and other similar devices for the ventition of class-rooms should be unqualifiedly condemned. They give consideration only to one of seven factors that control air conditions in a room, namely, the introduction of outside air. To obtain an adequate air supply is the simplest part of the ventilation problem. To obtain the correct wet-bulb temperature; to get proper distribution of the air; to maintain it practically free from dust and bacteria and objectionable odors, are the real difficulties in the ventilation of a class-room. These are ignored by those recommending patent ventilators and cloth-screens. The latter method obstructs the light and allows dust and bacteria to enter in considerable amounts; it has practically no redeeming feature. The children can be made just as miserable by shutting off the heat, with a marked saving in fuel, an important consideration at the present time.

"4.—Any mechanical ventilating equipment, if properly so-called, must consist of the following:

(a) Devices for introducing and distributing a variable amount of air according to varying conditions from 15 to 20 to perhaps 50 cu. ft. per pupil per minute. Distribution from one supply register in a room is a practical impossibility.

(b) The air should be controlled within a variation of less than 2° from a wet-bulb of 57°. Ordinary thermostatic control by a dry-bulb thermometer is wrong, as the dry-bulb temperature does not determine comfort.

(c) The air supply must be free from dust, bacteria, or other impurities. This means that an efficient air cleansing device must form a part of every ventilating equipment, no matter where the building is located.

(d) The entire mechanical equipment must be so constructed that every part of it from the building intake to the outlet registers in the room is readily accessible for thorough cleaning and repair. It is safe to say that less than 5% of the mechanical equipments installed in school buildings throughout the United States meet these requirements, and it is no wonder that teachers and others who are interested in this problem are not slow to criticize. A fan and heater, with a system of ducts, is not a ventilating equipment and should not be so designated. The latter is simply a device for blowing air into a room. With such a device the results obtained from its use are no better than bad ventilation by windows; frequently they are not as good.

"It is perfectly clear that the solution of our school ventilation problem does not lie in the return to the antiquated and inefficient so-called natural methods. To get the air space required for window ventilation would mean practically doubling the number of schools in the country. This is clearly out of the question and even if this were done it would be a difficult problem to obtain proper window area on opposite sides of the room. Neither is this question to be solved by the installation of the type of equipment just mentioned, which is usually designed by draftsmen, or salesmen; installed by tinsmiths, and operated by janitors. It lies rather in a better realization of what constitutes satisfactory air conditions and the insistence by those who are responsible for the installation of the same on the equipment being properly designed and installed and tested, when complete, to see that it will maintain the desirable standard.

"The tests in the New York schools reported by Dr. Josephine Baker may result in good or in harm, depending upon how carefully they are interpreted. Assuming that the results obtained are trustworthy, and we have no reason to think otherwise, the tests indicate that air conditions, from the standpoint of health at least, are better in the window-ventilated rooms than in those rooms ventilated by mechanical methods, and the results should awaken public school officials to their laxity and carelessness in the installation, and possibly in the operation, of these mechanical equipments. To conclude from the report that natural ventilation is to be preferred to mechanical would be a grave mistake and result in much harm. The entire matter emphasizes strongly the utter futility of making comparative tests of this kind. What we should do is to test the conditions in the rooms directly and to make comparisons, if desirable, of these tests.

"In conclusion, allow me to say that the common beliefs in so-called natural methods of this or that are oft times unwarranted. Natural methods are not the best. Nature is notoriously careless and inefficient. She creates with wasteful prodigality hundreds, yes thousands, of the lower forms of life that a few may live and fulfill their destinity. She ushers man on to the stage of life with a useless and troublesome vermiform appendix and many other vestigial remains of prehistoric ancestors to burden and clutter his anatomy. His natural skin covering is tender and soft, offering a woefully inadequate protection to the elements. But he is endowed with a brain, a truly wonderful organ, which he is expected to use for correcting and improving his condition. Each and every milestone that marks his road and measures his progress is an accomplishment or an invention in something artificial, something that makes him less dependent on nature and her various moods.

Civilization is artificial today almost in its entirety. Our clothing, our food and water supply, the houses we live in are artificial developments and we must of necessity maintain and promote our artificial life with artificial methods and devices. The cry of 'Back to Nature' is the cry of the reactionary; of the man who acknowledges defeat.

"Having this truth clearly in mind let us do all that we can to encourage and promote the development of artificial or mechanical ventilation, as in this direction only lies true progress."

AUTOMATIC TEMPERATURE REGULATION AS A FUEL CONSERVATION MEASURE

Advance Report of a Committee on Automatic Heat Control, as Furnished to the Fuel Administration.

(For presentation at the annual meeting of The American Society of Heating and Ventilating Engineers, New York, January, 1919.)

There are many appliances on the market for securing automatic temperature regulation. There are a number of substantial and well-established firms having representatives in principal cities, who make a business of manufacturing and installing these devices. We may state, therefore, that automatic temperature regulation is a commercial success, and that the various methods of securing it are effective in the particular field for which each was designed.

All devices for automatic temperature regulation are and must be devices making for economy of fuel, since they shut off the heat supply whenever the desired temperature has been attained, turning the heat on again only when the temperature drops below the desired point.

TENDENCY TO OVERHEAT DURING MILD WEATHER.

The human mechanism can flourish within a very close temperature range only. It is necessary, therefore, during about two-thirds of every human life, for that life to be carried on either within artifically-heated spaces or within unusually heavy wearing apparel. The artificial heating apparatus must be sufficiently powerful to maintain a temperature of around 70° F. when the weather outside is at its coldest. Since such low outside temperatures exist for a comparatively small part of the heating season only (it is below zero in this latitude only about 10% of the heating season) it follows that during the balance of the heating season the heating apparatus must be operated at less than full capacity. There is thus a constant tendency to overheat during mild weather in all classes of buildings.

AUTOMATIC REGULATION OF BODY TEMPERATURE NECESSARY.

The results of overheating on human efficiency and health are profound, and within the comfort limits of our normal life, overheating is more common and carries more harmful results by far than underheating. Granting, for instance, that 70° at normal humidity is most comfortable, we deteriorate far more rapidly, mentally and physically when living in an average of 80° than when living in an average of 60° even though the higher temperature may be compensated for by lower humidity at the high temperature, and higher moisture content at the lower temperature. The elaborate mechanism for automatic temperature regulation in the bodies of mammals and the serious results of very slight failure of this regulation to function properly, should indicate the wisdom of all practicable exterior measures that we can take to assist.

In all buildings or enclosed spaces, regardless of outside temperature, there will be some heat given off from the bodies of the occupants, from processes carried on, or from the sun. Unless very careful and unremitting attention is given by some person to any system of manual temperature control, these additional supplies of heat will cause an unnecessary and undesirable temperature increase. It is fair to say that the introduction of automatic temperature regulation is the only consistently practicable means of realizing the saving in fuel to be made by utilizing to the fullest possible extent these independent heat supplies.

HUMIDITY CONTROL DEPENDENT UPON TEMPERATURE CONTROL.

In considering temperature in its bearing on human activities and comfort, we cannot lose sight of humidity, as the two are most intimately correlated. So rapid are the changes in humidity conditions following our existing methods of varying it, that manual control is comparatively impossible. Automatic regulation of the temperatures of the untreated air and of the injection water when they are brought into contact, gives us very positive and responsive humidity control. The ability to control within very close limits the moisture content of air is necessary in many manufacturing processes, and so intimate and remarkable are the results following the automatic control of moisture content in such cases that we believe the future along this line holds wonderful possibilities. The saving of materials in process of manufacture otherwise wasted because of inconsistent or improper reactions must here be credited to automatic temperature regulation.

CONTROL OF TEMPERATURE OF DOMESTIC HOT WATER SUPPLY IMPORTANT.

The temperature of all domestic hot water supplies should be controlled automatically, as not only waste in fuel, and rapid deterioration of valves and packing, but serious scalding may result from overheated water. By domestic supplies we mean all water used for lavatories, laundries, baths, etc., whether in homes or offices or factories. In this connection the death in Chicago of a two-year-old child within the past month would have been averted by automatic temperature regulation of the hot water.

EXISTING CONDITIONS.

In general, manufacturing plants the country over, however heated, are without any automatic temperature regulation. When the weather is such that the heating plant causes discomfort, they open the doors and windows, and very seldom shut off any heating surface or reduce materially the coal consumption. Too often such neglect is based on the idea that exhaust steam is of no value, although in making it about nine-tenths of all the fuel burned was required, and in wasting it this nine-tenths is wasted. Automatic temperature regulation is at present vitally responsible for increased efficiencies in manufacturing processes, particularly as regards the saving in time. It has made possible the drying of lumber in months where it formerly took years. It has simplified greatly the production of many sorts of prepared food—such as is being sent abroad for the army—and has shortened materially the time required in such preparation. It should not be forgotten that the application of automatic temperature regulation in manufacturing plants usually results in the release of labor which could be used for other purposes. It is no uncommon thing, where automatic temperature regulation is not installed, to see a man devoting his entire time to the manipulation of the heating system and the windows or to the valves governing the temperatures for certain processes of manufacture.

The cost of heating buildings supplied from an outside source, especially when steam is used, is nearly always materially reduced by installing automatic temperature regulation. With such systems of heating, the occupants control the temperature in the easiest way, which is to open the windows, and seldom turn off the heat. When the coal is burned on the premises a natural human instinct to reduce labor as much as possible tends to some extent to prevent waste.

Only a few, certainly not over one in ten of the residences in this country have automatic temperature regulation, despite the very simple and inexpensive devices which, operating on the draft dampers of the heaters, will prevent any overheating and will even insure the maintenance of a reduced temperature during the night without any special adjustment.

In buildings having warm air furnaces for supplying heat, automatic temperature regulation, since it prevents to a great extent any hard firing unless ample cold air is being admitted or unless the building requires the heat, will make for longer life in fireboxes, grates, etc. In such installations, also, for the same reason, there will be materially less danger of fire from overheated parts of the apparatus.

A fair share of all of the public buildings are equipped with automatic temperature regulation, particularly those buildings having mechanical ventilation. This is done not only because fuel economy is sought, but also because, with such ventilation very rapid air changes are necessary and manual temperature control is impossible. There is a decided tendency to install automatic temperature regulation for street and railway cars, in order to take the fullest advantage of the heat given off by the occupants.

Practically all air conditioning apparatus wherever installed, if successful, has automatic temperature regulation in connection with the humidity control. Hot water domestic service heaters in public buildings are usually, when heated by steam, provided with automatic temperature control. We believe that comparatively few such heaters for residences and manufacturing plants are so controlled, though very simple and economical devices for the purpose, operating on the heater drafts, are available.

AUTOMATIC CONTROL IN OPERATION HALF OF TIME.

We believe that where automatic temperature control is installed, the device will be in operation limiting the emission of heat and the waste of fuel for fully one-half of the time during which the heating apparatus is fired.

It is unfair to claim from this a fuel saving of 50%, of course, since all sorts of heating plants reflect at the fire rather sluggishly the conditions in the building. With electrical heating, the saving is nearly directly in proportion to the hours turned off. With steam heating there is a constant heat loss from the pipes, and when the steam is turned on a cool radiator the rate of condensation momentarily is excessive. When steam is turned off from all the radiators or a large percentage of them, the pressure at the boiler increases rather slowly, and while such pressure increase is reflected ultimately in the rate of fuel consumption, it may be many minutes after the radiators are closed. With hot air heating in residences, for instance, where the temperature is controlled by the draft damper, even though the draft be decreased it will take some minutes for any decreased combustion rate to be manifest.

Observations of many different types of automatic temperature control, under varying conditions, and all available tests of such systems indicate strikingly that in order to maintain closely any fixed temperature there must be an almost continuous movement of the dampers or valves. Such persistent and continuous adjustment by hand is well nigh impossible.

RECORDS OF ACTUAL SAVINGS.

The following are some well authenticated records of actual savings:

1. Test by F. A. DeBoos in Kansas City, Mo., in an office building, heated by direct steam. (Proceedings of The American Society of Heating and Ventilating Engineers.) The steam was shut off 63% of the time between 8:00 a.m. and 6:00 p.m. during February, with an outside temperature of 29° although the temperature inside was maintained at 70°. These observations also indicated that the valve must be opened and closed around 2,500 times during a heating season, holding the room temperature within a range of one degree from the point desired.

2. Simultaneous tests of the temperature and condensation of two buildings of practically equal size at the University of Illinois (Prof. A. C. Willard) show a consistent decrease in the amount of steam required by the automatically-controlled building as the outside temperature increased, while the manually-controlled building became too warm as the outside temperature increased, with very little decrease in the amount of steam used. A saving of 17% of the steam required was made at the university, by maintaining 70° rather than 75°. The exact percentage of saving possible is difficult to prove.

3. Consistent observation extending over many years, by the boards of education at Toledo, Ohio, Erie, Pa., Kansas City, Mo., and other places where buildings of similar type and size are equipped with similar heating systems but with and without automatic temperature regulation, show an average saving of around 15% of the total fuel consumption per season by using automatic temperature regulation.

4. The introduction of automatic temperature regulation to street cars, as shown by tests made by the Chicago Railways Company and which, since electric heating was used were easily computed, show a saving by preventing overheating of well over 50%. This saving computed on the basis of 3 lbs. of coal per kw.-hr. means, for the 50,000 electrically-heated cars in the United States, a saving of nearly 750,000 tons of coal per season.

5. A two-weeks test was conducted in a residence at Overbrook, Pa., supplied by a central heating plant. The first week the plant was operated under hand control, and required an average of 2,180 lbs. of steam per day (measured by condensation). During the second week the house was under automatic control, and the average amount of steam consumed per day was 1,500 lbs. During these two weeks the average outdoor temperature was practically the same. This shows a saving, therefore, of 680 lbs. of steam per day, or at 50c per 1,000 lbs., 34c per day (American Radiator Company). The saving is over 31%.

6. F. W. Ballard in a paper read before the Ohio Society of Mechanical and Electrical Steam Engineers, describes a central heating plant operating at Cleveland, equipped with automatic temperature control. To quote from his statement: "This has been found in some cases to reduce steam consumption by as much as 25% to 30%."

7. Automatic temperature regulation installed on the heating plant in the First National Bank Building at Peoria, Ill., showed a saving of approximately 33⅓% in a test extending over a period of eight months as compared with the corresponding months of the previous winter. The test was conducted and the statistics were compiled by H. R. Wetherell of the National District Heating Association. The net saving in this building for the year was $158.95, which was considerably more than the cost of the very simple, self-contained type of automatic control installed.

8. H. A. Woodworth, M. E., Merchants Heat & Light Company, Indianapolis, Ind., made a seven-day comparative test on a

building with and without automatic temperature regulation, and developed a saving of about 35% in steam consumption through the introduction of the regulating equipment.

9. A large store at Hartford, Wis., heated by steam from a central station, and so having ready means of measuring the condensation, saved nearly $200.00 in one season by installing a single unit automatic temperature regulator.

COSTS.

The cost of installing automatic temperature control to an existing plant varies, of course, with the conditions. In manufacturing buildings, it is often possible to control a large number of heating units in the same room with one thermostat. While perhaps not so minute regulation will have thus be accomplished, a general condition will be attained of preventing overheating.

Where the building is considerable in size and has many rooms, a system of regulation having many units—such as the type using compressed air as motive power—or an electrical system, is least expensive and most satisfactory. With its control of each unit of radiation, varying the amount of heat as the varied exposure and heat source conditions of the building require, such a plant must reach a high efficiency. Maintenance seems to cost annually not to exceed 2% of the cost of the plant.

For buildings having but one or two rooms, and for residences of reasonable size, however heated, single-unit regulators, which may be self-contained, or electric or mechanical, give satisfactory results and the maintenance cost is negligible.

It may be roughly stated that a good system of automatic temperature regulation may be installed in a building for from 5% to 10% of the cost of the heating plant.

CONCLUSIONS.

The installation of automatic temperature regulation, or system for prevention of excess temperature, is a justifiable investment for all heating systems inasmuch as it very positively contributes to:

1. Conservation of fuel.
2. Improvement in health.
3. Gain in personal efficiency.

Those installations in which it is particularly a desirable and wise addition are:

1. All manufacturing plants in which a temperature of 60° F. or higher is maintained.
2. All offices.
3. All residences. For the smaller residences the type which has but one thermostat, operating on the heater drafts, gives excellent results.
4. All buildings heated from central stations, and particularly those having steam service. For many of these the single unit type of control is ample.
5. All buildings having mechanical ventilation. The air changes are so rapid and involve such quick temperature fluctuations that automatic temperature regulation is imperative from the comfort standpoint as as for many other reasons.
6. All service hot water heaters, particularly those having coils which are supplied with steam. The savings to be made are very great. Prevention of scalding is positive. Steam supply to the coils, or the drafts of the coal fired heater, or the supply to the gas fired heater may be controlled by automatic devices limiting the temperature of the water.
7. All manufacturing processes in which the exact control of the moisture contained in the air and the temperature of any of the materials are of importance.
8. All railway, elevated or street cars used for transporting human beings, particularly those heated by electricity.

For data incorporated in this report acknowledgment is due to Dr. E. V. Hill, of the Chicago Department of Health, to A. R. Root, of the American Radiator Co., Chicago, and to H. W. Ellis, of the Johnson Service Co., Milwaukee, Wis.

The committee submitting the foregoing report is made up of Samuel R. Lewis, chairman; F. F. Aldridge, L. P. Breckenridge, F. A. De Boos, H. A. Harris, M. C. Honeywell, F. W. Powers, H. W. Sweatt, W. S. Timmis and A. C. Willard.

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Iowa State Fuel Administrator on Fuel Waste.

"It's the waste—the unconscious, often unconscionable waste—of fuel in our homes that we must overcome now," declared Charles Webster, the Iowa fuel administrator, in a recent interview given to a representative of the *Des Moines Register*.

"It isn't the poor who waste fuel," said the fuel administrator, "nor is it the business man. In office buildings and stores, as well as in factories, the heating is done with reasonable economy. The business man counts the cost. It is in our homes.

"Last winter while calling on a neighbor, the conversation turned to the war and fuel. I had noticed the house was overheated, so I remarked: "You seem to have 'fuel to burn'—your home seems opressively warm.' 'That's the trouble with our furnace; it's either too hot or too cold,' replied the lady in a despairing tone, as if it was the act of God whether her house was too warm or cold. 'Where is your thermometer?' I asked. She kept that outdoors to show the outdoor weather, she said. She didn't need it in the house, because it was easy enough to tell when she was warm or cold.

"Haven't you a heat control of some kind?" Yes, they had a chain that connected with the dampers of the furnace, but she never used the chain until it got either too hot or too cold for comfort—and of course, she couldn't sit there all the day moving that chain up and down.

"That," said Mr. Webster, "is the case in thousands of homes. The house is either very warm or uncomfortably cold. When it goes over 68° F., you are wasting fuel and when you get the house cold, the tendency is to waste fuel to get it back to a comfortable temperature again.

"Thermostats that regulate the damper and draft of furnace or boilers are so cheap, considering the amount of fuel saved, that every home ought to have one. Any builder will tell you that a thermostat is as essential to making a house 'modern' as a bathtub—all new 'modern' houses are using them. They can be installed on any kind of a heating plant in any old house—and in one season they make good the cost in fuel saved.

"The first questions I ask a man when he complains to me about fuel is: 'How much do you waste? Have you got a heat control on the heating plant in your home?' I figure we could save 10% to 15% on our fuel if we all used thermostats."

MODERN PRACTICE IN VAPOR HEATING

VI.—The Moline System.

Editor's Note.—*For the purpose of this series of articles, a vapor, vacuum, vapor-vacuum, vacuum-vapor, atmospheric, modulated or thermograde system of heating will be considered as any system in which the steam pressure ordinarily carried is practically at atmosphere, or slightly below, or in which the returns are open to the atmosphere and where no pump or other positive mechanical device is employed to pull back the returns.*

The Moline system, which has been developed by the Moline Vacuum-Vapor Heating Co., Moline, Ill., possesses some unique features not encountered in any of the other systems previously discussed. One of these innovations is the use of a lock-shield globe valve on the return end of each radiator and another is the use of an ejector fitting to produce a pull on the return lines of greater intensity than can be secured by simply opening the return line to the atmosphere or even by connecting the air-vent line to the chimney and employing the chimney draft.

The piping system, of which a typical arrangement is illustrated in Fig. 2, consists of a two-pipe arrangement, the steam line carrying the steam or vapor from the boiler to the radiators and the return line carrying the air and condensation from the radiators back to the boiler. At that point the water enters the boiler and the air is drawn into the ejector fitting which discharges a mixture of air and steam into the condenser. Here the steam is condensed, the water finding its way back to the boiler by way of the condenser drip (through a check-valve, along with the condensation from the return line), the air going out of the system through the special air trap and vacuum valve.

The Moline system, while advocating the use of hot-water radiators, does not consider their use absolutely necessary; in a large number of cases where old systems employing steam radiators have been remodeled the old radiators have been allowed to remain. Of course the use of steam radiators makes it necssary to place the control valve at the bottom and for this reason alone the hot-water type is preferable.

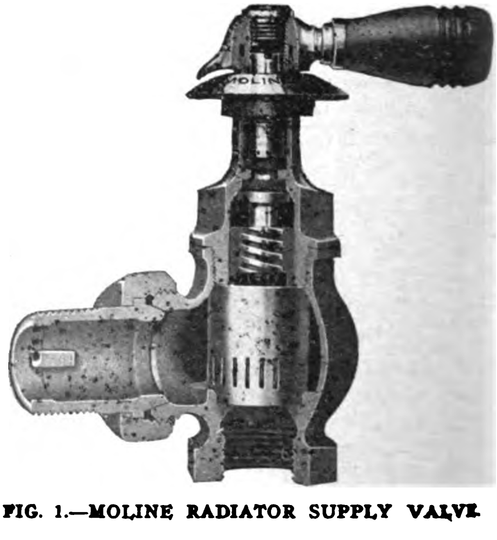

FIG. 1.—MOLINE RADIATOR SUPPLY VALVE

The radiator supply valves, which are illustrated in Fig. 1, resemble a common globe valve in which a slotted sleeve has been placed around the disc so that the disc will open these slots or ports gradually as it rises past the openings. The number of slots in the sleeve determine the quantity of steam which will flow for a given rise of the disc and the sleeves are arranged and sized so as to suit any size of radiator.

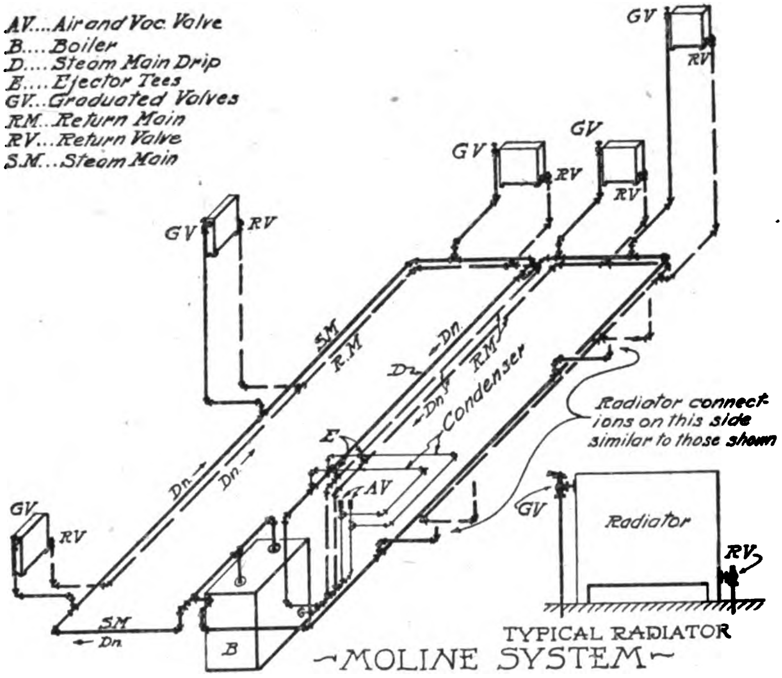

FIG 2. TYPICAL LAYOUT OF MOLINE SYSTEM.

The radiator return valves are all ½-in. and are of the lock-shield type, as illustrated in Fig. 3. They are also provided with an interior sleeve having small perforations which allow the water and air to pass without permitting the loss of an undue amount of steam. Being adjustable these valves may be set to suit any condition of service and will also permit the shutting off of the radiator and its connections in case of a leak or a broken section.

Probably the most important item in the whole system is the little steam ejector which is operated by the steam or air pressure at the end of the supply main just before it drops down to enter the boiler return. The arrangement of the device is shown in Fig. 4 which illustrates how the steam or air under pressure in the steam line blows out through the nozzle of the ejector fitting, creating, by its velocity, a suction around the jet, this suction drawing out the air from the return lines and discharging the mixture into the condenser. The connecting of this ejector near the point where the steam main drops down under the water line takes the place of an air valve at this point.

The steam used to operate this device is condensed in the condenser coil and there gives up its heat. This heat is oftentimes made use of in a desirable way, the most common being the partial heating of the cellar by placing the condenser coil on the ceiling.

The air trap, with which is combined a

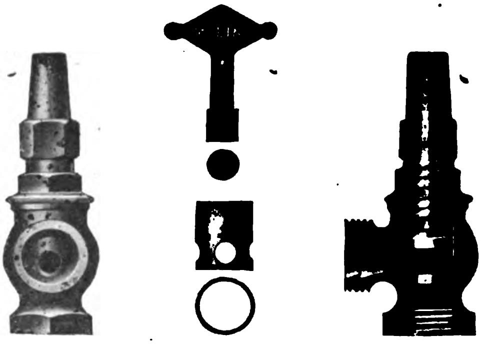

FIG. 3.—MOLINE RADIATOR RETURN VALVE.

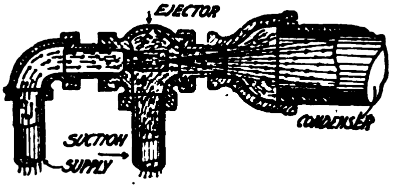

FIG. 4.—SECTIONAL VIEW OF EJECTOR.

vacuum valve, is shown in Fig. 5, the operation being as follows:

AIR VALVE AN ENORMOUS VENT VALVE.

The air valve itself is simply an enormous vent valve (when compared to the minute openings obtained with the ordinary automatic air valve) and operates by the expansion and contraction of the air contained in a float with an open bottom; no expansion post or volatile liquid is used in this trap. The trap allows the air to discharge into the pipe shown on which is placed the vacuum valve. The function of this valve is to close off and prevent the return of air into the system whenever the pressure falls below that of the atmosphere.

In sizing the piping for this system the schedule shown in Table I may be used if the length of the mains does not exceed 100 it. Each elbow should be counted as 10 ft. additional run.

No horizontal supply branch is reduced to less than 1-in. and no horizontal return branch to less than ¾-in., while all supply mains are made 2-in. or over. The sizes of risers are ordinarily made at least one size larger than the radiator valve and, if there are turns in the line, they are made two sizes larger, the increase being made immediately below the radiator valve.

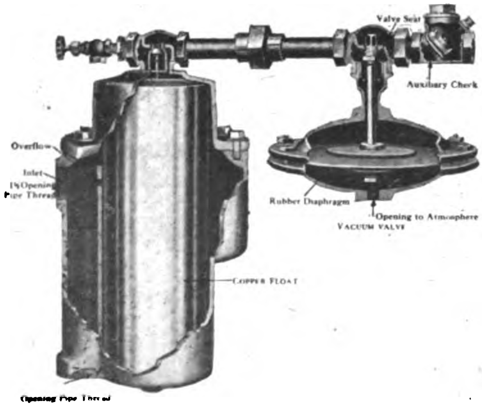

FIG. 5—AIR TRAP USED WITH MOLINE SYSTEM.

TABLE I.

Equivalent Direct Radiation Sq. Ft.	Steam Supply, In. Diam.	Dry Air and Water Return, In. Diam.	Wet Return, In. Diam.
450	2	1	1¼
750	2½	1¼	1¼
1350	3	1½	1½
2000	3½	2	2
2700	4	2	2
3600	4½		2
4700	5		2
7500	6		2½
11000	7		2½
15600	8		3
21000	9		3
28000	10		4
44500	12		4

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Current Heating and Ventilating Literature.

Under this heading is published each month an index to the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the articles mentioned may be obtained from* THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.

WORKSHOPS

Heating and Ventilation of Workshops. Ills. 1200 w. Engr—July 5, 1918. Arrangement of a low-pressure hot-water system with reinforced circulation. 40c.

Steam-Heating of Workshops 2000 w. Mech Wld——May 17, 1918. The principal factors involved. 40c.

STEAM HEATING

Dripping One-Pipe Steam-Heating Systems. Albert L. Baum. Ills. 1200 w. Power—Aug. 6, 1918. Measures that will tend to obviate all forms of noises and render quick heating an easy matter. 20c.

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Heating Engineers Nominate New Officers.

The following ticket for officers of The American Society of Heating and Ventilating Engineers has been named by the society's nominating committee, P. H. Seward, chairman:

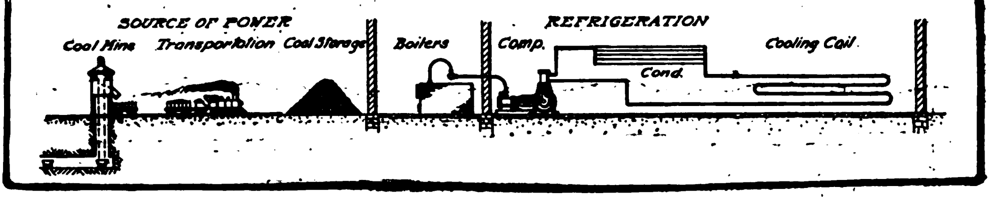
President, Walter S. Timmis, New York.

First vice-president, Dr. E. Vernon Hill, Chicago.

Second vice-president, M. F. Franklin, Philadelphia.

Council: F. R. Still, Detroit; Howard H. Fielding, Denver, Col.; Champlain L. Riley, New York; Fred W. Powers, Chicago; Frank G. Phegley, Cleveland; Robert W. Pryor, Jr., New York; Harry E. Gerrish, Minneapolis; and George B. Nichols, Albany, N. Y.

AIR COOLING AND REFRIGERATION



THE ARCTIC-POWNALL SYSTEM OF ICE MAKING

It is almost impossible to consider refrigeration work without including its application to ice making; not necessarily to the large artificial ice plants but at least to small building and group building installations. As there is less likelihood in such plants of having expert ice employees and owing to the probability that the persons so utilized from time to time will do this work somewhat as a side issue, along with their other more engrossing duties, it is most essential to make the handling of the artificial ice as easy as possible and to make the production of a fine clear and sparkling product assured without an undue amount of attention in the interim. One of the most successful methods of producing clear, sparkling ice with the minimum amount of labor and the maximum amount of facility is embraced in the Arctic-Pownall system, a brief outline of which is covered in this article.

The plan shown in Fig. 1 is that of the freezing tank, the one illustrated being of 35 tons capacity and utilizing 300-lb. cans. The sections of the tank at the top show how the cans are arranged—sixty to a section and six cans wide by ten cans long. The circulation of the brine is indicated by the arrows but the exact manner in which this is accomplished is more readily understood by reference to Fig. 2 which is a general cross section of the freezing room.

The vertical centrifugal pump P at one end of the central canal picks up the brine and discharges it through the brine cooler BC where it is cooled; this same pump also

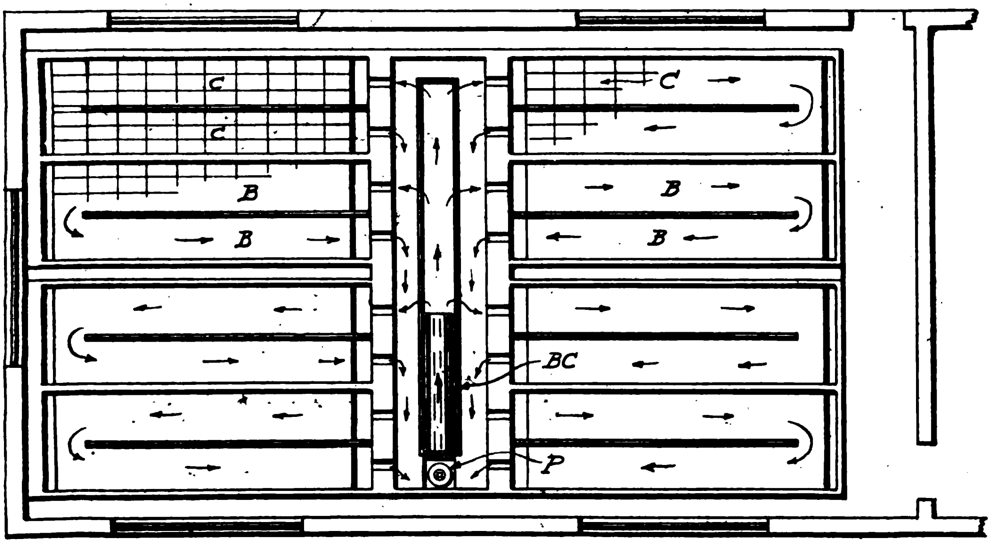


FIG. 1.—PLAN OF FREEZING TANKS USED WITH ARCTIC-POWNALL SYSTEM.

maintains a slightly higher level in the central discharge canal so that the brine flows by gravity from this central canal down through the lower openings into the various sections. After entering the sections the brine flows along past the cans located on one side of the middle baffle and around the end, returning on the opposite side of the baffle; thus all the cans are brought into the direct path of the brine flow. The brine then flows out of the upper connection between the section and the central trough which forms the return channel. The propeller pump takes its suction from the return channel discharging the brine through the cooler into the feed channel and thus begins the second round of the cycle.

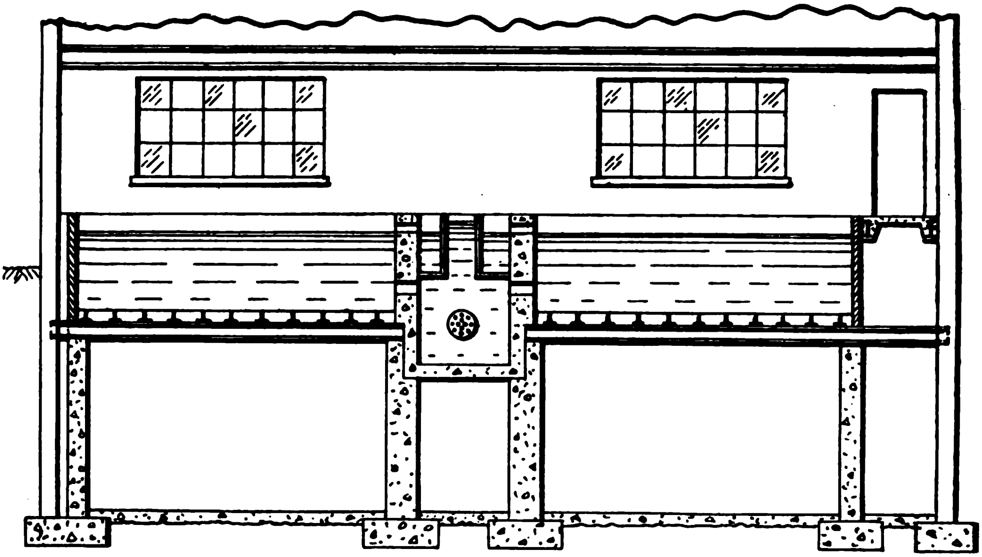


FIG. 2.—CROSS-SECTION OF FREEZING ROOM.

HOW THE ICE IS REMOVED.

The ice cans used in this system are not removable; instead they are fixed in permanent position and so remain.

When a section has become frozen the cold brine is cut off and the ice is permitted to temper. In the meantime a recharge of water for filling the cans immediately after the ice is removed has been run into a storage tank. The brine in the section or unit ready to be pulled is then circulated through the coils in the storage tank which cools off the incoming water to about 42° F. and, at the same time, warm the brine to about 36° F.

The brine warmed to 36° loosens the grip of the ice on the cans and the ice is hoisted from the can by a hand hoist, tackle, or other means, a lifting rod being frozen into the center of the top of the ice cake for this purpose. As soon as the ice is removed by the opening of one valve all the cans in the section are simultaneously refilled with water, the cold brine valve is opened and the section is ready to freeze the new charge of water.

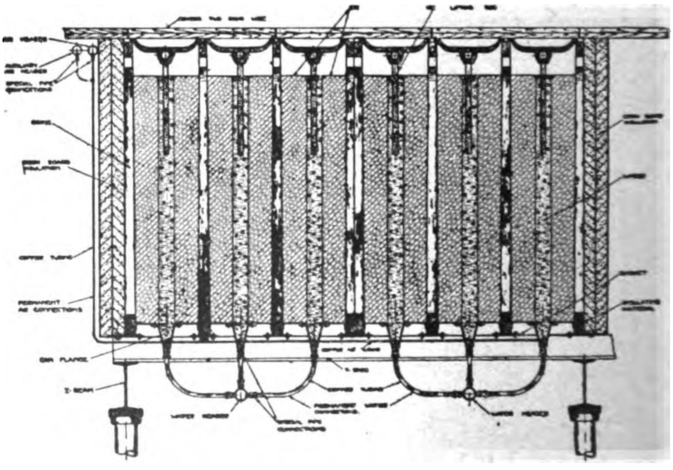


FIG. 3.—DETAIL OF TANK CONSTRUCTION AND PIPING CONNECTIONS.

In the freezing process to produce clear ice a certain amount of air must be frozen into the ice and the impurities (which are frozen out as the water solidifies and which are driven toward the center of the can sometimes producing a hard and bitter "core") must be gotten rid of before the can is fully congealed.

This is accom[illegible] om pipe connection [illegible] bottom [illegible] d with water [illegible] stand [illegible] during [illegible]

frame is used upon which the cans are supported, the frame being carried by heavier I beams. The cans are bolted tight to the tee irons and a special gasket is used between the can and the iron. After testing with water a special insulating compound is poured in which flows evenly around the bottom of the can.

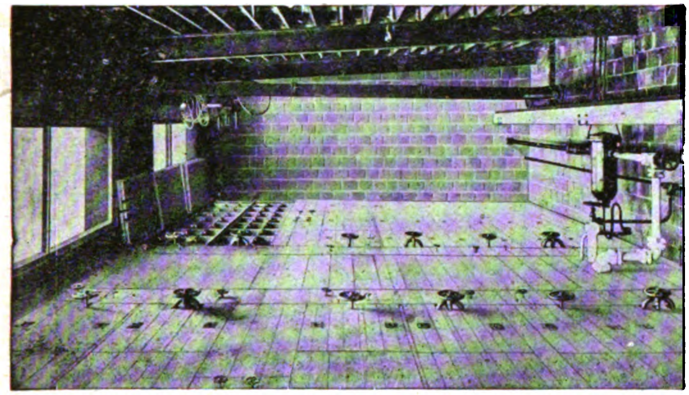


FIG. 4.—VIEW OF FREEZING ROOM WITH SOME OF CAN TOPS OPEN.

The compressed air used may vary in quantity from a minimum of about 0.3 cu. ft. per minute per can up to [illegible] cu. ft. at the beginning of the freeze where very hard water is encountered. After the formation of 1-in. of ice all around the lower rate can be used for the balance of the freezing work.

A view of the freezing-room with some of the can tops open is shown in Fig. 4, the valve stems sticking above the floor being to control the brine flow to the various sections.

A detail of the tank construction and the piping connections for same is shown in Fig. 3. It will be noted that the air header is run close up under the floor of the freezing room and that the branches (which are made of copper tubing) drop down at each can and connect to the branch from the water header which is run below the cans.

The method of removing the core before it is frozen into the cake is as follows:

After filling the cans with water and turning on the compressed air which is maintained at about 3 lbs. pressure in the pipe the bubbles maintain a constant agitation in their rising up through the can thus washing-off the surface of the forming ice and preventing the impurities lodging thereon. As the bottom of the cans is exposed to the cold brine the ice forms first on the sides, gradually extending toward the center, the top and bottom following. When the ice has frozen so as to leave only about 10 lbs. of water in each can this water is allowed to drain off by opening a waste valve on the filling pipe. Thus all the water which might go to form an impure core in the cake is run off and the cans are then refilled with fresh water from the filling pipe. It is claimed that this scheme eliminates 98% of the impurities in the water and as all the cans in a section can be drained and refilled simultaneously the labor of so doing is very small.

To keep the brine from leaking through around the bottom of the cans a tee iron

Notes.

On electrically-operated units a "Monogram" circuit breaker can be installed so as to automatically stop the compressor whenever the pressure unduly rises. This circuit breaker is made by the Refrigerating Specialties Co., 9 So. Clinton St., Chicago, Ill.

The De La Vergne Machine Co., New York, makes a specialty of high-speed ammonia compressors for direct connection to oil, gas or high-speed engines or to electric motors. The advantages for such an arrangement are claimed to be a saving in power of about 10%, sometimes running as high as 15% to 20%, a reduction in space of about 40% and a cutting down of the cost of engine-room equipment of about 10%.

C. G. Tagliabue Mfg. Co., has issued a new catalogue No. 370-R which is a handy reference book on indicating and recording thermometers for ice and refrigeration plants.

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New Incorporations.

Lawler Tank Heater Co., Peoria, Ill., capital $100,000. Incorporators: S. B. Adelman, F. F. Mendenhall and L. Adelman.

New York Blower Co., East Orange, N. J., has been organized by Emil A. Briner to manufacture blowers, etc. Offices have been opened at 370 Central Avenue, East Orange.

THE WAR AND THE HEATING ENGINEER

Circular No. 21.

As a matter of record the restrictions of the now famous "Circular No. 21" of the Priorities Division of the War Industries Board on "Non-War Construction" are given herewith. The circular is addressed to all manufacturers, jobbers, distributors, dealers and consumers of building materials. After reciting the resolutions on which the Priorities Board had based its general policy, Circular No. 21 continues as follows:

That all interested in the manufacture and sale of building materials, as well as those interested in building projects of every character, may have a clear definition of or a ready means of ascertaining the uses to which such materials may be put, and be advised of building projects which may be prosecuted during the war with the approval of the War Industries Board, this circular is issued.

Structures, roads, or other construction projects falling within the following classifications are hereby approved, and no permits or licenses will be required therefor:

(1) After having first been cleared and approved by the War Industries Board, those undertaken directly by or under contract with the War Department or the Navy Department of the United States or the United States Shipping Board Emergency Fleet Corporation, the Bureau of Industrial Housing and Transportation of the United States Department of Labor, or the United States Housing Corporation.

(2) Repairs of or extensions to existing buildings involving in the aggregate a cost not exceeding twenty-five hundred dollars ($2,500).

(3) Roadways, buildings, and other structures undertaken by or under contract with the United States Railroad Administration or a railroad operated by such administration.

(4) Those directly connected with mines producing coal, metals, and ferro-alloy minerals; and

(5) Public highway improvements and street pavements when expressly approved in writing by the United States Highways Council.

No building project not falling within one of the foregoing classes shall be undertaken without a permit in writing issued by or under the authority of the Chief of the Non-war Construction Section of the Priorities Division of the War Industries Board.

Should one contemplating building conceive his proposed project ~~to be~~ in the public interest or of such essentiality that under existing conditions it should not be deferred, then he will make a full statement of the facts in writing, under oath, and present same to the local representative of the Council of National Defense, applying to such representative for his approval of the proposed construction. Should such local reprcstative approve the construction project, he will promptly transmit the application, stating clearly and full his reason for approving same, to the Chairman of the State Council of Defense, for his consideration. If approved by the latter, he will transmit it to the Chief of the Non-War Construction Section of the Priorities Division of the War Industries Board, Washington, D. C., for consideration, if need be, further investigation, and final decision. Should the application be finally approved by the Priorities Division a construction permit will issue which will constitute a warrant to manufacturers and dealers who have taken the pledges of cooperation above mentioned to sell and deliver building materials required in the construction of the licensed building project.

While it is not the policy of the Government to unnecessarily interfere with any legitimate business, industry, or construction project, it must be borne in mind that there is an imperative and constantly increasing demand for labor, material, and capital for the production and distribution of direct and indirect war needs, to satisfy which much non-war construction must be deferred. A full realization of this fact by all loyal and patriotic citizens, including State and municipal authorities, is all that is required to postpone such construction activities as interfere with the war program. The State and local representatives of the Council of National Defense are with confidence depneded upon to fully acquaint the whole people of these United States with the pressing need for the most rigid economy, measured not only in terms of dollars but in terms of labor, materials, and transportation service. The construction projects which must now be deferred may be undertaken when we shall have won the war and will then furnish employment to the returning artisan now on the battle front as well as those who will then be released by strictly war industries.

Yours very truly,
(Signed) Edwin B. Parker,
Approved. *Priorities Commissioner.*
(Signed) Bernard M. Baruch,
Chairman War Industries Board.
Washington, D. C., September 3, 1918.

At the instance of the Merchants' Association of New York a later ruling was issued providing that practically all buildings under way could be completed and dealers in building materials could continue to supply needed material for such purposes until further notice from the War Industries Board.

War Industries Board's Priority List.

The official list of industries which are to be accorded preference in the building line, as well as a detailed statement showing what construction may be undertaken without a permit and providing a means of giving immediate consideration to proposed consrtuction through local boards, are the subject of a recent ruling of the War Industries Board.

The industries which are given preference are listed in four classes, in the order of their importance. Class I includes:

(*a*) Direct Government work and war activities.
(*b*) Hospitals and sanitariums.
(*c*) Shipbuilding and railroads.
(*d*) Practically all plants engaged in the production of food, fuel, and iron and steel products.

Class II includes:

(a) Public utilities and plants engaged in the manufacture of

1. Brass and copper products.
2. Iron and steel products, such as tools, wire rope, steel rails, ferro-alloys, and mine producing metals and ferro-alloy minerals.

Class III includes secondary items of products listed in Class I and II.

Class IV includes:

(*a*) The manufactuer of

1. Farm inplements.
2. Fertilizers.
3. Textiles.
4. Soap.
5. Pulp.
6. Paper.
7. Drugs and medicines.
8. Chemicals.
9. Boots and shoes.
10. Bags.

(*b*) Laundries.
(*c*) Newspaper plants.

This classification serves to put the business of the country on a fairly definite war basis and from it we may judge in just what direction construction work will be most active.

How to Plan Building Construction During the War.

To aid in carrying out the recent modification of the building restriction rulings of the War Industries Board, the co-operation of the 48 State councils of defense and the 5,000 county councils of defense throughout the country has been requested. Local councils will investigate the necessity for any proposed construction, and transmit recommendations to the War Industries Board. The procedure outlined is as follows:

"Any person interested in a construction project must apply, with a full statement of the facts under oath, to the appropriate local representatives of the various State councils of defense.

"This representative of the State council will investigate the necessity of the proposed construction and transmit recommendations to the State council for review.

"The State council will review the case, and, if it decides in favor of the construction, it will at once send its recommendation, with a full statement of all the facts, to the Non-War Construction Section of the Priorities Division of the War Industries Board. The Non-War Construction Section will grant or withhold the permit and so notify the state council of defense, and the individual concerned.

"If the State council decides against the proposed construction, it will notify the person concerned that his project has been disapproved.

"The War Industries Board will inform all persons applying directly to it that they must first take up their projects with the appropriate local representative of the State council of defense.

"The ability of the War Industries Board to enforce this whole plan rests upon the fact that it controls priorities and has also secured from the manufacturers of building materials a pledge not to supply materials for projects which are not authorized under the regulations of the War Industries Board."

Coal Directions Issued by Federal Fuel Administrator for Illinois.

How to handle the proposition of using one-third bituminous coal and two-thirds anthracite coal, which is now before the householders of Illinois, is answered by the U. S. Fuel Administrator for Illinois, who states:

No householder need suffer for fuel during the coming winter, providing he follows the directions of the fuel administration. Co-operate.

Sixty-six and two-thirds per cent of the hard coal (anthracite) used during the period from April 1, 1916, to March 31, 1917, has been allotted Cook county consumers, who are exceedingly fortunate in being one of but thirteen counties in Illinois which will receive hard coal.

One-third of the hard coal needs must therefore be supplied with soft coal. Your patriotic co-operation to meet this situation is desired.

Hard coal (anthracite) has not been distributed heretofore as directed. It is our responsibility to see that the public does not suffer. Therefore we instruct both dealer and consumer—

1. That base burner, heating stove, kitchen stove or range, and hot-water supply-heater consumers who used hard coal (anthracite) during the period from April 1, 1916, to March 31, 1917, order now their entire requirements from the dealer who supplied such consumers during the period from April 1, 1916, to March 31, 1917. All of their requirements up to two tons each, including coal now in their bins, will be delivered to each consumer on or before October 20, 1918. The balance to which the consumer is entitled will be delivered to him as receipts of hard coal (anthracite) warrant after October 20, 1918.

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2. That furnace (hot air, hot water, steam, and vapor) consumers will not be permitted to receive, and dealers will not be permitted to deliver, hard coal (anthracite) for use in such furnaces before October 20, 1918, and then not until such consumer has stored for consumption soft coal equal to one-third of the previous annual coal consumption of such consumer. Soft coal must be burned in all furnaces until Christmas, 1918, and the hard coal saved for severe winter weather. If soft coal supply is not now in your bins, get it now, while it is available, weather is good, and streets clear. Of the two-thirds of furnace consumers' hard coal (anthracite) allowance, one-half should be delivered to the consumer between October 20, 1918 and November 25, 1918, which will be thirty days before the same may be used in furnaces. The balance of the allotment to furnace consumers will be delivered as received after November 25, by the dealer who supplied the house or apartment now occupied by such furnace consumer during the period from April 1, 1916, to March 31, 1917.

3. That consumers having Spencer heaters, Newport boilers, and similar type heating plants that used buckwheat-sized hard coal (anthracite) or pea-sized coke during the period from April 1, 1916, to March 31, 1917, may receive and dealers who supplied such consumers during that period may now deliver one-third of the annual requirements of consumers having those types of heating plants. After all consumers having the above type of heating plant, who have applied to their respective dealers, have been supplied with one-third of their annual requirements of buckwheat-sized hard coal or pea-sized coke, a second one-third of such annual supply may be delivered by the dealer to the consumers so supplied by him, there being a sufficient supply of buckwheat-sized hard coal (anthracite) or pea-sized coke to supply now two-thirds of the anual requirements of consumers using that fuel.

4. Dealers must return to consumers all orders they have from consumers whom they did not supply from April 1, 1916, to March 31, 1917, and consumers must place the same with the dealer who did supply their needs during that period.

5. Dealers must take all orders tendered to them by consumers who were their patrons between April 1, 1916, and March 31, 1917, and from new residents in houses to which they supplied hard coal (anthracite) during that period.

6. Hard coal (anthracite) consumers who cannot get dealers to take the orders or who cannot find what dealers supplied the house they now live in, during the period from April 1, 1916, to March 31, 1917, or who bought of dealer now out of business, must file their orders, properly certified to, at this office, 306 South Wabash avenue, Chicago.

Fan Manufacturers Form War Service Committee.

In accordance with a request of the Electric and Power Equipment Section of the War Industries Board, a war service committee has been formed of fan manufacturers, made up of J. F. G. Miller, American Blower Company; H. W. Page, B. F. Sturtevant Company; Charles Clarage, Clarage Fan Company, and H. W. Wendt, Buffalo Forge Company. The fan manufacturers are asked to furnish the government with all available data regarding the fan makers of America, including the names of the various companies, chief executives, etc.; also the principal engine and turbine builders that each manufacturer depends on for motive power, together with other information.

The fan manufacturers have arranged to have an executive representative of each company in Washington to confer with the War Industries Board to see how fan manufacturers can best co-operate with the government. The work to be accomplished by the fan manufacturers includes the elimination of sizes and types of apparatus not necessary, for the period of the war, and to place information before the War Industries Board of the capacities and schedules of each company for each class of apparatus built by it which is used in the conduct of the war. The committee will also present to the War Industries Board the requirements of fan manufacturers for outside purchases of motive power.

In a second report the committee recommends to the fan manufacturers the elimination of all sizes and types of apparatus not necessary to win the war. All members are urged to present a list of all different sizes and types of apparatus they are prepared to build, and a separate list of those types and sizes they are prepared to discontinue for the period of the war. The committee recommends that the following be discontinued: cast-iron volume exhausters or blowers larger than a 30-in. planing mill fan; also special discharge fans, and steel plate fans for heating and ventilating work. The making of only one type of engine is also recommended. It is urged that odd sizes of cylinders be eliminated, unless 20 or more are made on one order.

The Official Facts on Our Fuel Problem.

In a statement issued by the Committee on Public Information, Harvey O'Higgins, associate chairman, states:

The war programme of the nation demands 80,000,000 more tons of coal this year than last. We are calling for 8,000,000 tons of steel ships and to manufacture and deliver the steel for them will take 14,000,000 tons of coal. 3,000,000 tons are needed to carry our average monthly delivery of troops to Europe, and 4,000,000 tons to transport their supplies. One hour of intensive artillery action at the front uses up 1800 tons of steel, which it takes 7200 tons of coal to produce. To manufacture and transport the 60,000,000 shells that were fired by the French in the battle of Verdun called for the consumption of nearly 9,000,000 tons of coal.

The demands for coal this year have increased in American industrial plants 18%; in gas and electric utilities, 15%; in shipping, 30%; in the railroads, 7%; and in domestic consumption, 13%. It has been impossible to provide for these increases by increased production. There have been 224 new mines opened and weekly production has risen as high as a 17% increase over the corresponding week of 1917, but there has not been the necessary mine labor available to meet the whole demand and there have not been coal cars enough to keep the coal moving from the mines.

In an attempt to meet the deficit, the Fuel Administration has carried out a thorough campaign of saving. It has undertaken to inspect the country's 250,000 steam-producing plants, and hopes to save thereby 20,000,000 tons of coal a year. As a result of this inspection in Connecticut alone 80 plants are saving 50,000 tons annually. In Chicago three plants are saving 74,000 tons by substituting electricity and water power for steam.

It is evident, however, concludes the statement, that the greatest economies will have to be practised this winter in order to avoid another serious coal shortage.

Women Taking Up Engineering.

Unusual and radical changes are taking place daily as a result of war demands, states A. H. Krom, director of engineering of the U. S. Employment Service. Up to the present engineers as a class have been governed largely by tradition. Once a mechanical draftsman, always a mechanical draftsman. Now technical men are changing from one line of work to another.

"Oddly enough," says Mr. Krom, "they are changing their attitude toward technical women. We are daily getting calls for women to do drafting for service in new and unaccustomed lines of work."

Heating Men in Military Service.

Frank Van Inwagen, vice-president of the Illinois Engineering Co., Chicago, Ill., has finished his course at the United States Naval Academy at Annapolis, and has been assigned to duty as ensign on a transport in overseas service. He completed his course at Annapolis in four months.

Harold S. Maddock, of the Thos. Maddock & Sons Co., Trenton, N. J., has received his commission as first lieutenant. He was made a second lieutenant five months ago. Lieutenant Maddock is stationed at Camp Dix.

Major J. W. H. Myrick of the Ancient and Honorable Artillery Company of Boston, and president of the Autoforce Ventilator

Co., Boston, has recently been appointed chairman of the Board of Instruction, Local Board Selective Service Division 6, City of Boston. Major Myrick has been assigned to take draftees to the rifle range at Wakefield. Other offices held by Major Myrick are vice-president of the National Matches Civilian Teams Association and director of the National Rifle Association.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

New York Chapter Compiles Standards for Mechanical and Natural Systems of Ventilation.

Standard conditions that should obtain in a school room with a mechanical system of ventilation and with the open-window or similar method, were presented at the opening meeting of the New York Chapter by a special committee appointed for the purpose. The compilation is a direct result of the agitation started by the New York City Department of Health virtually proposing that future New York public school buildings should be ventilated by natural means.

The meeting was held at the Building Trades Employers' Club and was preceded by a "Forbes" dinner. As a preliminary to the main business of the evening James A. Donnelly presented a large number of stereopticon views on war subjects, many of which were unusually thrilling. The scenes shown were mostly of the western front.

President Seward announced that the society's committee on research was now ready to proceed with the work of establishing a research laboratory at the station of the Bureau of Mines, in Pittsburgh. He stated that ten men would be appointed from the New York Chapter to canvass the trade in the metropolitan district for the necessary funds to maintain the laboratory.

He also announced that at the request of the local fuel administration authorities, a report on conservation of fuel had been prepared by a committee headed by Thomas Chester. This report was considered so useful by the New York fuel administration that copies of it were forwarded to all county fuel administrators throughout the State with instructions to see that the recommendations were put into effect.

In the absence of Perry West, the chairman of the committee on school room ventilation, the report of this committee was presented by A. S. Armagnac. He stated at the outset that the committee was a unit in its feeling—that there was no need of a controversy between the various schools of thought on the matter of ventilation but that, on the contrary, any system is acceptable and to be recommended provided it meets the requirements. The work of the committee, therefore, was focused on defining the requirements. Following is the committee's report:

Your Committee appointed by President Seward to formulate a report as the basis of discussion on the above subject at the October meeting of the Chapter has to report as follows:

1st. That it is the sense of this committee that the heating and ventilation of school rooms, having to do as they do with the comfort, health and welfare of the school children, who in turn form such a large percentage and such an important and susceptible portion of our population, are deserving of the highest consideration from the members of our profession, as well as from all others connected with this subject.

2nd. That we recommend that this subject be taken out of the class involving controversies between advocates of different methods of heating and ventilation and placed purely on the scientific basis of defining and maintaining proper conditions by whatever method is best suited under the particular conditions to be met.

3rd. That we recommend the following as standard requirements for proper air conditions in a school room:

Dry-bulb temperature—65° F. to 70° F. (standard 67° F.)

Relative humidity—From 60% at 65° F. to 40% at 70° F. (standard 50% at 67° F.)

Dust counts per cubic foot of air—(a) Not over 5000 particles with Hill dust counter.
(b) Not over 150,000 with Palmer dust counter.
(c) Not over 1500 with Graham-Rogers plate.

Bacteria counts on a two-minute plate—10 (showing on gelatin at 20° C. in four days).

Cubic feet of air per pupil per minute—20 to 40 (standard 30 cu. ft.) with a distribution of 90%, and with not more than 10 parts of CO_2 in 10,000 parts of air by volume.

Odors.—The room to be practically free from objectionable odors, gases, and other objectionable foreign matter as determined by one coming in from the outside air.

Air motion at the air inlets to be from 2 to 3 miles per hour (175 to 265 ft. per minute).

4th. If in any case these conditions can be properly and economically maintained without a mechanical ventilating plant, either by means of open windows or by natural means, a mechanical plant could be omitted. That in our judgment this would require:

A minimum of 500 cu. ft. of air space per pupil, with windows on at least opposite sides of the room.

Automatic humidifying apparatus for each classroom.

Positive means for exhausting foul air.

Outside air conditions showing not more than 6000 particles of dust with Hill dust counter (or equivalent) per cubic foot, or 25 counts of bacteria on a two-minute plate for any considerable time during the school year.

Practical freedom from objectionable odors and gases in the air surrounding the building.

Proper regulation of the windows and other items of the natural method at all times to correspond with the outside weather conditions.

In the ensuing discussion the various sections were taken up in detail and the discussion showed that the report as a whole met with the approval of those present.

Before adjourning President Seward announced that the November meeting, on November 17, would be devoted to "Coal Requirements in House Heating Systems."

Illinois Chapter Elects New Officers.

The first meeting of the Illinois Chapter for the year 1918-1919 was the occasion for the election of new officers. Those elected were: President, G. W. Hubbard; vice-president, E. J. Claffey; treasurer, August Kehm; secretary, Alfred E. Stacey. Board of governors: Dr. E. Vernon Hill, Lloyd Howell and John C. Hornung.

The topic for discussion was "Mechanical Versus Window Ventilation for Schools." Professor John W. Shepherd, of the Chicago Normal College, raised the point that inefficient temperature control was a frequent cause of failure on the part of mechanical systems to give the desired results and that a higher grade of intelligence is needed on the part of janitors and engineers in charge of the mechanical equipment.

Other speakers paid their respects to the architects who so frequently place restrictions upon the ventilating engineer, especially with respect to the distribution of flues in a building.

The sentiment was unanimous in favor of the mechanical system and the opinion expressed that nothing in the much-discussed tests, reported by Dr. S. Josephine Baker, which were made in the New York City public schools, was sufficient to alter this conclusion.

Annual Meeting of Kansas City Chapter.

New officers were elected at the opening meeting of the Kansas City Chapter which was also the chapter's annual meeting. The report of the nominating committee was unanimously adopted, the new officers being as follows: President, J. G. Pease; vice-president, William N. McIntyre; treasurer, B. Natkin; secretary, John H. Kitchen. Board of governors: F. J. McMorran (chairman), Walter E. Gillham and Martin Hauser.

It was decided to devote the November meeting to a discussion of mechanical versus natural ventilation.

In spite of the fact that over 25% of the membership of the chapter is engaged in war work, the attendance compared favorably with that of previous meetings. Six new members have been added to the roll since the last meeting.

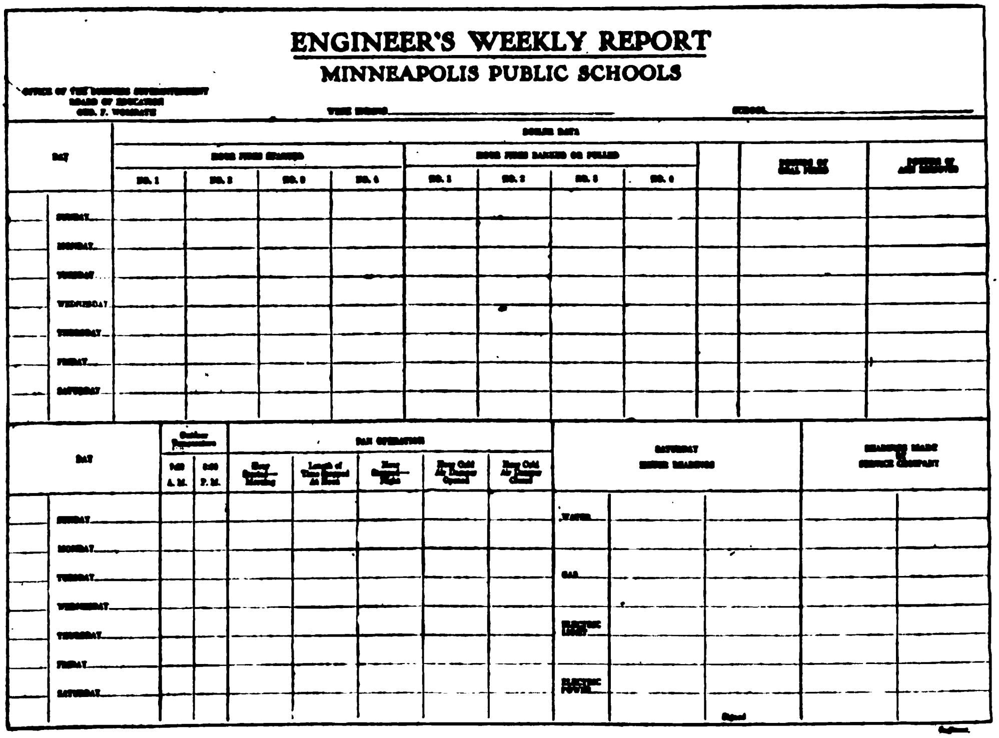
The chapter has been requested to formulate ventilating requirements for the use of the Kansas State Teachers' Association. This work will be undertaken by the chapter's legislation committee, consisting of Messrs. Field (chairman), Natkin, McMorran, Downes, Gillham and Kitchen.

Minneapolis Public Schools to Be Limited to 75% of Normal Amount of Fuel.

One of the first cities to put into effect a fuel-rationing plan for its public school buildings is Minneapolis. In a notice just sent out to the principals and engineers of its public school buildings, Business Superintendent George F. Womrath has promulgated rules designed to save 25% of the normal amount of fuel burned, the instructions superseding all previously-issued rules where any conflict occurs. We are indebted to A. L. Sanford, mechanical engineer, for a copy of the rules, which are as follows:

"1. Engineers will start fires and furnish steam in buildings when the outdoor temperature at 7:00 a.m. on school days is 50°F. or less. When the outdoor temperature is between 50° F. and 55° F., the engineer shall use his discretion about starting fires, depending on the outlook, whether the day will be cloudy and cool, or fair and warmer.

"2. Continuation of firing of boilers on a warm day with windows and doors open is a needless waste of fuel and will not be tolerated. Engineers should bring rooms to proper temperatures, shut off steam valves



ENGINEER'S WEEKLY REPORT
MINNEAPOLIS PUBLIC SCHOOLS

FORM FOR RECORDING DAILY CONSUMPTION OF FUEL.

bank fires, holding boiler in readiness for sudden temperature changes during school hours.

"3. The Fuel Administration has requested that if rooms should rise above scheduled temperature the steam be shut off rather than windows opened. Principals and engineers will see that this request of the Fuel Administration is enforced.

"4. Outside hall doors are to be kept closed consistently. If two or more outside doors are open, the entire corridor is soon robbed of all heat, placing an added tax on the heating system. It is recommended that the principal in each building will station two or more of the older boys at the hall doors to open and close all hall doors immediately before and immediately after the children leave or enter the building.

"5. In order to keep loss of heat from building at a minimum during night, engineers or janitors are to draw window shades completely, covering glass exposure. Shades to be left down until arrival of teachers. This is not imposing any extra work on the janitors as the rules already call for lowering the shades halfway.

"6. Wherever practicable it is requested that furnace fires be banked at night in order to keep boiler settings at an even temperature and save fuel, kindlings, gaskets, etc.

"7. Following are the maximum temperatures to be followed during the season 1918-19:

Class rooms	65°-68° F.
Gymnasium	55°-60° F.
Swimming pool	70°-72° F.
Showers and dressing room	70°-72° F.
Shops and manual training	60°-65° F.
Toilets	50° F.

"8. Direct radiation will be used for all heating, and windows for ventilation until November 1, at which time all fan systems will be started. After November 1 no open windows or window screens will be allowed.

"9. At schools having sufficient exhaust steam from fan engines and pumps, the fan may be run before November 1 and the fan coils used for heating the building. As soon as the building is heated, the fan must be shut down.

"10. The following procedure for starting fan systems will be followed:

"As soon as coils are heated and fan and engine started, open cold-air dampers for a few minutes in order to fill entire building with fresh air. Then close cold-air dampers and re-circulate air within the building until classes start. Do not turn steam on direct radiation until after re-circulation of air has been started. Wherever humidifiers are installed they are to be used continuously during operation of fans.

"11. In order to comply with the requests of the Fuel Administration and as a basis for future coal allotments, it is necessary that engineers keep a careful estimate of their daily consumption of fuel. For the use of our engineers we are furnishing blanks as approved by the Fuel Administration covering the desired data. Determine the weight of contents of truck or wheelbarrow used in handling coal. Keep a record on tally sheet of number of loads used, transferring number of pounds to "Weekly report blank" at convenient time. Weekly report blanks are to be completely filled out and mailed in duplicate to the Board of Education Repair Shop, 245-9th Avenue, North, not later than each Saturday, 5:00 p. m. New monthly report blanks are being furnished and these must be filled out and mailed not later than the last day of each calendar month.

"We feel confident that each employe will cheerfully co-operate with us in following the request of the Federal Fuel Administration as outlined above, as this is a patriotic measure and is a means of determining each man's loyalty to the United States Government."

◆

Report on Space Required for Heating and Ventilating Plants.

A special meeting of the Committee on Standardization of Schoolhouse Planning and Construction of the National Education Association was held recently at the headquarters of the heating engineers' society, in New York, to further consider the space requirements of heating and ventilating plants. Those present included Frank Irving Cooper, chairman, Frank G. McCann, chief of the division of ventilation, New York Department of Education.

Other features of the committee's work that came up for consideration included fire prevention and protection, and safety to lives. Charts were exhibited illustrating these features, as well as the percentage of space allotted to sanitary facilities in various types and sizes of buildings, in both grade and high schools.

Tabulations of percentages of space allotted to the various parts of the heating plant, janitorial service, etc., were prepared from a wide variety of buildings. The tables showed remarkable variations in allowances for such spaces. Several reasons were brought forward for this, but it was decided to continue the study with a view to fixing an irreducible minimum for each part of the plant.

Bureau of Mines Finds Waste of Fuel Oil.

Fuel sufficient to operate the railroads of the United States for one month is being wasted every year by the users of fuel oil. This is the conclusion that has been drawn by experts of the Bureau of Mines, Department of the Interior, who have been co-operating with the Fuel Administration in a general survey of the use of fuel oil for power purposes in the United States. They find that last year 160,000,000 barrels of fuel oil were used and that 40,000,000 barrels, or one-fourth of the entire amount, was wasted and might have been saved by more intelligent operation of plants and proper firing. This is equivalent to 10,000,000 tons of coal.

With such a situation confronting the country, both the Bureau of Mines and the Fuel Administration have sent into those parts of the country where fuel oil is extensively used a number of engineers who have been visiting the plants and demonstrating to the men where losses occur and how they may be stopped. As one result of the investigation a handbook for boiler-plant and locomotive engineers in the efficient use of oil fuel has been issued by the Bureau of Mines, giving instructions to all those who have oil-burning plants.

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Definition of "Frigories."

A correspondent of the *Refrigerating World* writes to inquire the meaning of the expression "300,000 frigories par heure," and its equivalent in English, as well as the equivalent of "6000 calories un kilo." The *Refrigerating World* gives the following answer to the correspondent's question:

In the metric system as shown throughout the world, a heat unit (or calorie) means the amount of heat required to change the temperature of one Kilogram (Kg.) of water one degree Centrigrade. A British thermal unit (B. T. U.) means the amount of heat required to change the temperature of one pound of water one degree Fahrenheit. One Kg. is 2.20462 lb., and one degree C. is 1.8 degree F. One calorie is therefore equal to 2.20462 × 1.8 = 3,96832 pound - degrees or B. T. U. One American ton of refrigeration is equal to the melting effect or latent heat of fusion of 2000 lbs. of ice per 24 hours. This means 2000 lbs. × 143.4 = 286800 B. T. U. per 24 hours, or 11950 B. T. U. per hour, or 199.167 B T U per minute. Therefore, 11950 ÷ 3.96832 = 3011.35 calories per hour is equivalent to one American ton of refrigeration.

The object of refrigeration is to remove heat units, usually below 32° F. which is the freezing point of water. The French think it desirable to distinguish these negative heat units (frigories) from the ordinary positive heat units (calories) and, therefore, have since a few years, commenced to speak of "frigories" in connection with refrigeration and ice making, but the heat value of frigories and calories is exactly alike, and both are equal to 3.96832 B. T. U. The "300,000 frigories par heure" (per hour) therefore represent simply 300,000 ÷ 3011.35 = 99.7 American tons of refrigeration per 24 hours.

Incidentally the British ton of refrigeration differs from the American ton of refrigeration, because based on the gross ton of 2240 lbs., which is 12% greater than the short ton of 2000 lbs. The capacity of the French plant is, therefore, equal to 300,000 : 3370 = 89 British tons of refrigeration per 24 hours, or 99.7 ÷ 1.12 = 89 tons.

◆

Are Gas Heaters Harmful to Health?

The recent receipt of circular matter on gas heating appliances made by the Sanitary Heating Company, Brooklyn, N. Y., including the Solar Grand fireplace heater which, it is claimed, "operates perfectly without a flue connection," led to an inquiry as to what became of the products of combustion. In reply, the manufacturers state:

"Permit us to say that the Solar Grand heater made by this company operates with a luminous or 'white' flame. We use 'white' flame instead of the laboratory expression of 'yellow' flame for the reason that the flame is as white as an incandescent light.

"This result is obtained by the Argand principle of promoting a perfect combustion. After combustion takes place, the products are directed through a system of superheated baffle plates and diaphragms which absorb any imperfections that might escape in the primary combustion and permits all the products to be discharged into the room without odor or offense and a 30 cu. ft. consumption laboratory test confirms this fact, and also shows that the CO properties are nil or 'not sufficient for record.' These tests have been confirmed by large laboratories in the country.

"When a purchaser is not convinced as to the sanitary qualities of the products of these heaters, we give him the option of a damper for venting the heat products into the flue. But in almost all cases practical experience soon convinces him of the unnecessary loss and waste of heat, and he soon decides to utilize all of the units, which gives him 100% efficiency."

Heating the Essington Plant of the Westinghouse Company.

In a new manufacturing plant of the size and importance of the Essington Works of the Westinghouse Electric and Manufacturing Company, at South Philadelphia, Pa., the methods of heating and ventilating are of more than passing interest. These works were erected during the past year and in the process of construction many records for speed were established.

The factory represents a new industrial development of the Westinghouse interests, which was made necessary because the East Pittsburgh plant of the company, although already very much congested does not permit of further expansion as further ground is not available. But as the constantly increasing volume of business made additional facilities imperative, the company was compelled to look elsewhere. This resulted in the acquisition of a tract of land in Delaware County, Pa., comprising 500 acres. This site is located in Essington, about nine miles south of Philadelphia on the Delaware river. Of the 500 acres 110 acres have been set apart for factory buildings proper, while the rest is to be used in the erection of houses for the employees. Already 200 dwellings are now under construction, but eventually it is expected to increase this number to about 1500 houses.

While the contemplated plans for this new development calls for a plant four times the size of its present capacity, an idea may be formed how extensive these works will eventually be when it is understood that there are now completed seven structures with a total floor space of 35 acres. These buildings are all of fire-proof construction. The material used is tile, concrete and steel. The roofs are of concrete and the windows have steel sashes. There are seven buildings, the pattern-storage, the foundry, the forge and blacksmith shop, the power house, two machine shops and one erecting shop. Ground was broken on April 1, 1917, and the first building was completed August 15, the first product was turned out in the foundry on November 20, in the same year. The first manufactured shipment from the plant was made in February, 1918, the first commercial shipment was made on March 23, and all departments were at least in partial operation on April 1, 1918, exactly one year from the date building operations had been started.

As far as the heating and ventilating problem of the plant is concerned, generally speaking, ventilation was not considered as essential, because this feature was already taken care of in the design of the buildings, where large areas of ventilating sash are provided, and where the ratio of cubic contents to the number of occupants in each building is unusually large. Small exhaust systems of ventilation were installed in the west end of machine shops Nos. 1 and 2 to provide for unexposed offices, wash and toilet rooms. In the various shop buildings the indirect blower systems were installed, their selection being due primarily to their adaptability to this class of structure, their lower first cost and better distribution of heat, as well as convenience of operation.

Direct heating was installed in the office section of the pattern storage building as well as in the building proper. The direct heat in this case provides the necessary individual control in the offices, and the most economical system for the rest of the building. Direct heat is provided in the toilets and wash-rooms throughout the plant to prevent feezing when the indirect blower systems in the shops are shut down.

The various systems come under the general classification of "vacuum heating." Steam is supplied through large exhaust mains in tunnels to the different buildings and the water of condensation is drawn through the return mains by vacuum pumps located in the power house. Vacuum or thermostatic traps are used on each unit of radiation throughout the installation, which, in conjunction with the vacuum pumps, makes it possible to obtain a positive circulation of steam throughout the entire plant at a low initial steam pressure.

The indirect blower systems in the Machine and erecting shops, and in the foundry, were divided into two units, on account of the size of the buildings. Each unit consists of a constant-speed motor-driven blower and indirect heater. The heater is so subdivided that the air temperature may be adjusted to suit any outside temperature. The heated air is carried through a system of overhead sheet-iron ducts, with outlets carried down the columns to distribute the heat near the floor. Provision is made in each blower room, so that air may be taken directly from outside, or the war air recirculated from inside the building. It is the intention that all air be recirculated during the night, and when the shops are not in operation, as this will effect a considerable saving in steam. At other times, during mild weather, the system may be operated partly on outside air and partly on recirculated air. In extremely cold weather, it will be necessary to operate entirely on recirculated air, in order to properly heat the buildings.

This does not apply to the foundry, where it will be necessary to operate on outside air during working hours, owing to the nature of the work performed in the building.

The following data, tabulated for each building, give detailed figures regarding the size and capacity of apparatus, as well as information showing temperature ranges and length of time required to completely change the air in each building:

HEATING SYSTEMS.

Machine shop No. 1 and No. 2 (each shop):

Two-180-in. steel plate blowers, having a capacity of 57,000 cu. ft. of air per minute each.

Two-indirect heaters, containing 5,130 sq. ft. of heating surface each.

Approximate air change: One change each 46 min. temperature range, 10° to 60° F.

Erecting shop:

Two-160-in. steel plate blowers, having a capacity of 43,000 cu. ft. of air per minute each.

Two indirect heaters, containing 3,160 sq. ft. of heating surface each.

Approximate air change: One change every 56 min. Temperature range 10° to 60° F.

Foundry:

Two—160-in. steel plate blowers, having a capacity of 50,000 cu. ft. per minute each.

Two—indirect heaters, containing 5,440 sq. ft. of heating surface each.

Approximate air change: One change every 58 min. Temperature range, 10° to 50° F.

Pattern Storage Building:

Direct Heating: approximately 13,000 sq. ft. of cast-iron wall and column radiation. Temperature range, offices, 5° to 70° F., remainder of building, 10° to 60° F.

Forge shop:

Direct heating in office and toilets only.

EXHAUST VENTILATING SYSTEMS.

Machine shop No. 1:

One 55-in. steel-plate exhauster, having a capacity of 3300 cu. ft. of air per minute.

Air change: Offices, one change every 15 min.; wash-rooms and toilets, one change every 10 min.

Machine shop No. 2:

One 50-in. steel-plate exhauster, having a capacity of 2900 cu. ft. of air per minute.

Air change: Offices, one change every 15 min.; wash-rooms and toilets, one change every 10 min.

Figuring Chimney Losses by Chart.

A chart for making quick estimates of the fuel loss in almost any chimney, due to low CO_2, has been prepared by the Uehling Instrument Co., New York. In using the chart, the percentage of CO_2 (shown in Column C) is connected with the money now being spent per year for coal (shown in Column B) and the intersection of the connecting line with Column B gives the dollars lost in the form of heated gases escaping through the chimney.

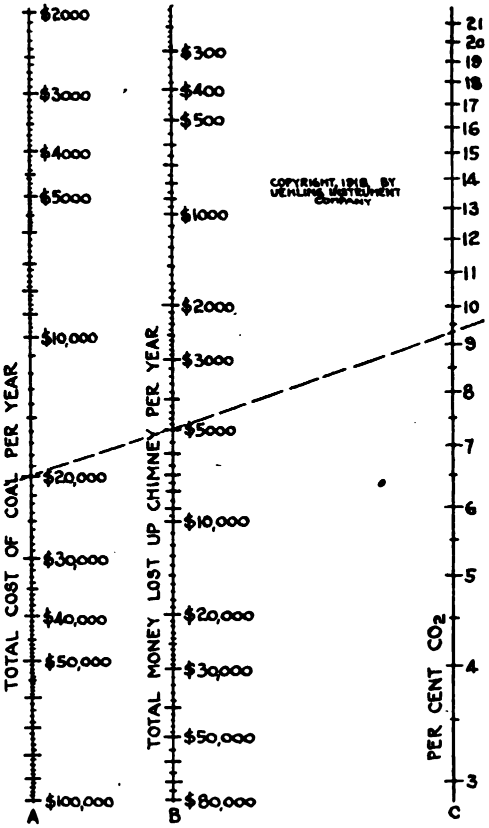

CHART FOR FIGURING CHIMNEY LOSSES.

For example: If $20,000 is spent per year for coal burned in a furnace whose average CO_2 registers 9.3%, what is the approximate chimney loss per year?

Solution: Connect the $20,000 (Column A) with the 9.3% (Column C) as indicated by the dotted line drawn across the chart illustrated, and the intersection with Column B shows the approximate yearly loss to be $5,000.

This chart is based on a flue-gas temperature of 600° F. and an outside temperature of 60°F. It has been assumed that coal has a calorific value of 14,500 B. T. U. per pound of combustible.

NEW DEVICES

The Trane Master Pump.

A new type of condensation pump with only one moving part and having the advantages of both the centrifugal and piston pumps, has been brought out by the Trane Co., La Crosse, Wis. It is known as the Trane master pump. Like a piston pump it operates against high pressures, and as a centrifugal it pumps large volumes at low pressure. The impellor is the only moving part. The pump is described as requiring no oiling, is not affected by dirt and requires no repairs.

A cut of the impellor is shown in Fig. 1. This impellor, with its shaft casing and stuffing box, is all there is to the pump. Water enters the inlet, fills up the numerous pockets on the edge of the impellor and the channel around them and is drawn by the velocity of the impellor and pockets around to the discharge opening. At this point the channel is blocked by a partition so that the water must pass out through the discharge. As the pockets are emptied of water by centrifugal force, both are emptied and are ready to receive a new supply of water as soon as they reach the position directly under the inlet opening.

Although the pump is apparently simple in

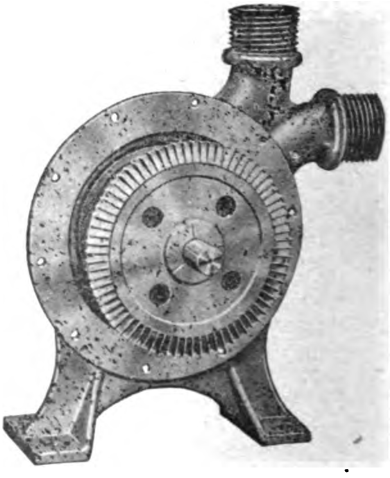

FIG. 1.—IMPELLOR AND CASING OF TRANE MASTER PUMP.

construction, the manufacturers state that its design is the result of delicate adjustment of the factors of speed, diameter of impellor, size of channel, shape, depth and number of pockets. The pump has a heavy cast-iron body, fitted with brass bearings. The impellor is of brass, machined throughout and balanced.

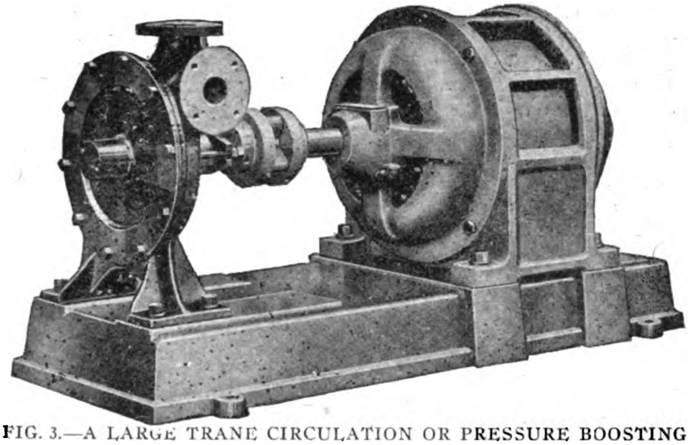
FIG. 3.—A LARGE TRANE CIRCULATION OR PRESSURE BOOSTING UNIT.

The outfit consists of a cast-iron receiver of 10-gal, capacity, elliptical in shape, allowing for a long, powerful float arm on the inside. The float is connected by levers to a float switch on the outside of the receiver. The pump and motor, which are mounted on a single cast-iron base with the receiving tank, are connected by a flexible coupling. General electric motors are used for all sizes.

In a circular describing the Trane master pump, capacities and other information are given for the four different types comprising this line. In the same connection some hints are given on the selection of the proper type. For example, if no pressure reducing valve is used and the heating plant is operating on full boiler pressure, the A or B pump is recommended. Where there is a pressure-reducing valve, usually the C or D type must be selected. As a matter of economy the company furnishes only one size receiving tank and recommends that in all cases where there is over 3000 sq. ft. of radiation, a 20-gal. or 30-gal. steel tank be connected in parallel with the receiver. The capacities of the pumps run from 10 gal. per minute to 1000 gal. per minute or even larger.

These circulation pumping units are also arranged for turbine, engine or belt drive.

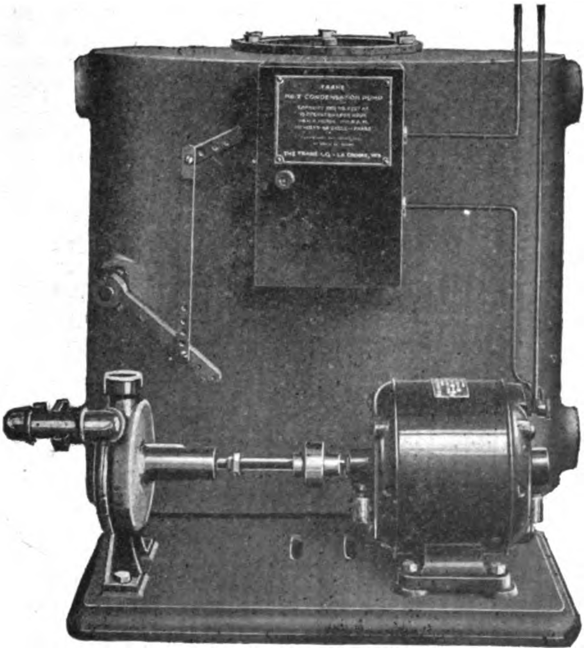
FIG. 2.—TRANE MASTER PUMP CONNECTED WITH RECEIVER.

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New Publications.

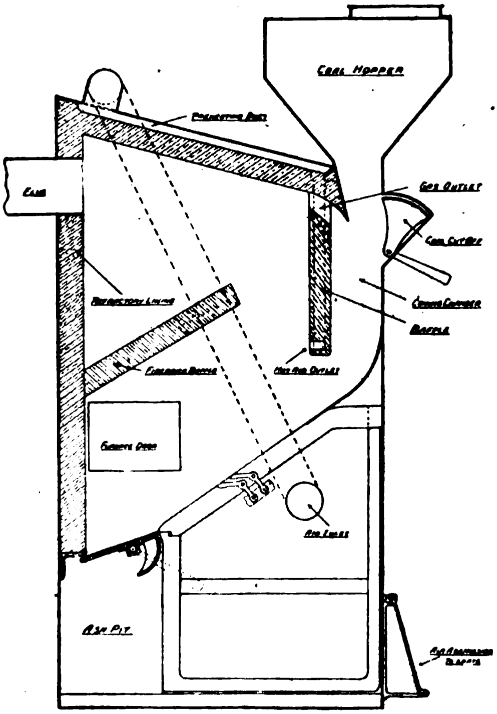
Chemistry in Overalls is the title of a readable booklet devoted to the industrial research laboratories of Arthur D. Little, Inc., Boston, Mass. This organization, which is the result of more than 30 years' experience in the application of science to industry, has recently occupied its new laboratory building, which is described as a factory in miniature where the many and various problems that arise in the modern arts of production may be studied. The booklet is replete with views of the different rooms and sections of the building, all of which are shown equipped with the latest types of analytical and experimental apparatus. Under "What We Do," the company states that it solves problems in manufacture, engages in industrial research and makes chemical analyses. The company also manages corporations engaged in chemical manufacture, and develop methods and processes, including the design of apparatus, the construction of works and the systematizing of manufacture in them. The booklet then proceeds to give typical instances of the company's work from a study of the chrome tanning of leather to the development of a waterproof paper. Size 6 x 9 in. (standard). Pp. 36.

Saving Coal in Boiler Plants, by Henry Kreisinger, is one of the latest publications of the Bureau of Mines (Technical Paper 205). The paper is described as covering the field between two other Bureau of Mines publications, Technical Paper 80 on "Hand Firing Soft Coal Under Power-Plant Boilers," and Bulletin 97 on "Sampling and Analysis of Flue Gases." The present bulletin is written for the fireman, the engineer and the owner of the small or medium-size plant which is, as a rule, hand-fired. Size 6 x9 in. (standard). Pp. 24.

◆

Trade Literature.

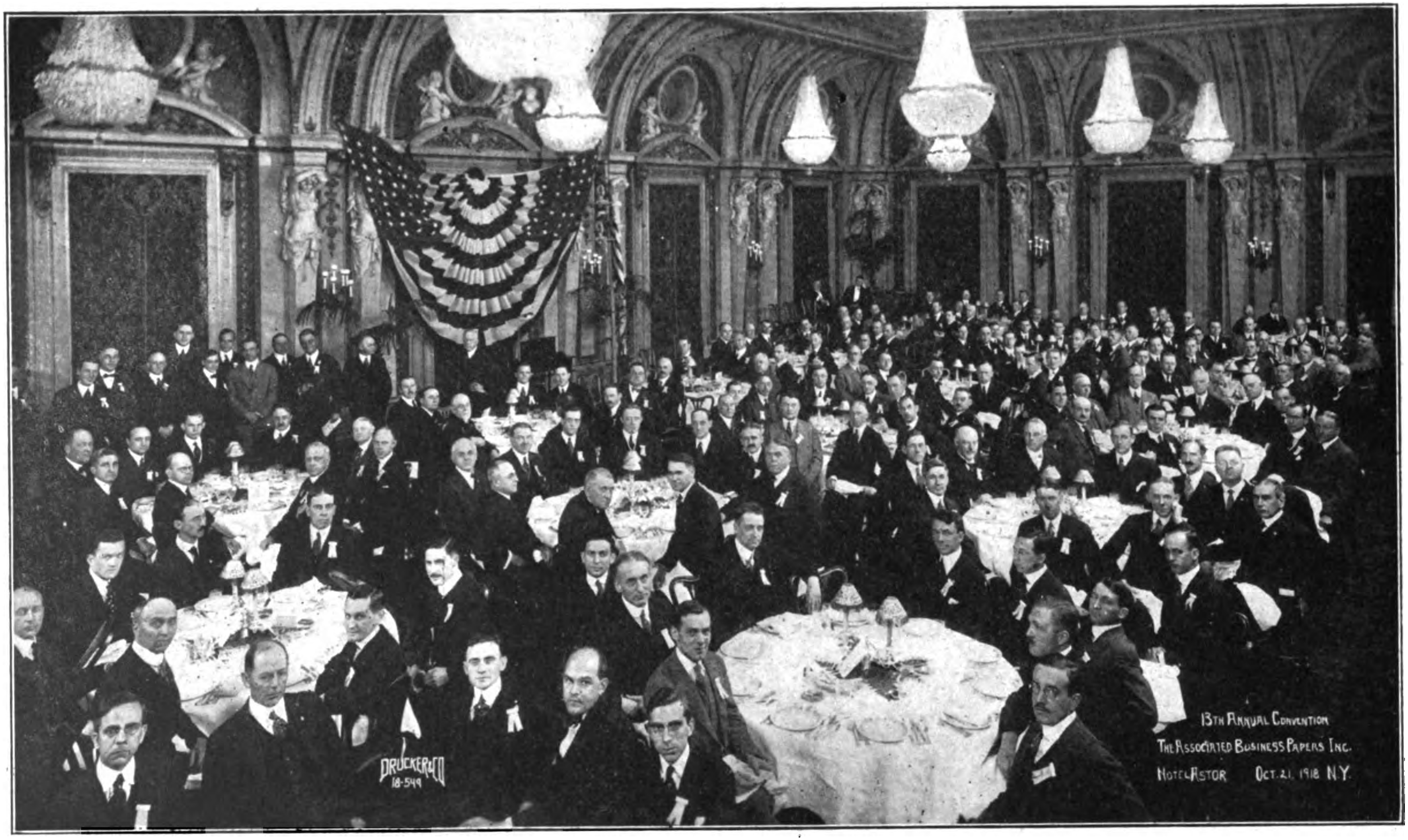
Devine Apparatus for the Chemical and Allied Industries is the subject of a booklet issued by the J. P. Devine Co., Buffalo, N. Y., whose apparatus for drying fruits and vegetables by the vacuum method was described at the last summer meeting of the heating engineers' society. Illustrated descriptions are given of the Devine vacuum pans for the concentration of sugar juice, milk, etc., and of the Devine vacuum evaporators, built in single and multiple effect. The booklet concludes with an illustration of the company's experimental laboratory in Buffalo. Size 4¼ x 5½ in. Pp. 32.



DOMESTIC LIGNITE HEATER.

Domestic Lignite Furnace is a new type of heater brought out by R. D. McLaurin, of the University of Saskatchewan, Saskatoon, Canada, and described in newly-issued circular matter. One of the heaters was exhibited in operation at the recent chemical exposition in New York. The essential features of the furnace include a carbonizing chamber, a combustion chamber, means for directing the course of the hot gases, inclined shutter gate so constructed that screenings and dust are prevented from escaping into the ashpit, dumping grate so constructed that ash may be dumped while live coal is retained on the inclined grate, and coal hopper of sufficient capacity to keep the furnace operating 24 hours on two charges. It is claimed that by this design complete combustion of volatile matter is obtained. The feed is automatic.

Patterson Hot-Water Service Heaters, made by the Patterson-Kelley Co., New York, are presented in a well-prepared catalogue recently issued by this company. The fact that the company's experience as water heating engineers extends over a period of 30 years lends special interest to the latest developments in its line of hot-water service heaters and convertors. Each type, for instance, has been brought out to meet certain requirements of service and may be used with exhaust steam or live steam in connection with low-pressure, vacuum or vapor heating systems. In addition to the designs shown the illustrations include a typical installation showing how a Patterson hot-water service heater and storage tank may be supplied with steam from a low-pressure boiler during the heating season, the condensation returning by gravity. It is cross-connected to a hot-water boiler, for which it furnishes storage capacity when the heating boiler is not in use. This illustration also shows how the temperature regulator may be used to control the admission of steam to the heater and to operate the damper on the hot-water boiler. Detailed capacity tables for the various sizes and types are included, the catalogue closing with two pages of data on the Patterson-Berryman feed-water heater and purifier. Size 6 x 9 in. (standard). Pp. 32.


13TH ANNUAL CONVENTION
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HOTEL ASTOR OCT. 21, 1918 N.Y.
DRUCKER & CO
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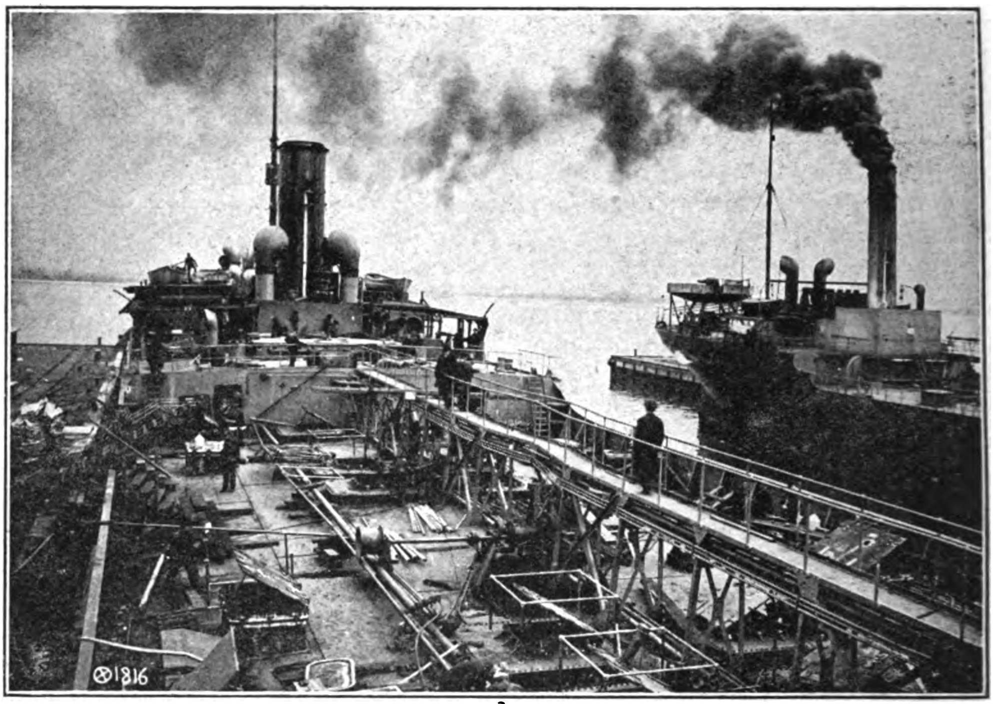
MEMBERS OF THE TRADE PRESS AT THE DINNER OF THE ASSOCIATED BUSINESS PAPERS, INC., HOTEL ASTOR, NEW YORK, OCTOBER 21, 1918.



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A LINK IN THE "BRIDGE TO PERSHING."

America's New Merchant Marine.

This merchant ship is almost ready to leave our shores filled to overflowing with supplies for our Allies and our army in France, paid for by the money the government receives in exchange for Liberty Bonds.

It is typical of one class of ship being turned out by the Emergency Fleet Corporation.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, OF THE HEATING AND VENTILATING MAGAZINE, published monthly at Cooperstown, N. Y., for October 1, 1918.

County of New York, }
State of New York. } ss.

Before me, a notary public in and for the State aforesaid, personally appeared A. S. Armagnac, who, having been duly sworn, according to law, deposes and says that he is the Editor of The Heating and Ventilating Magazine, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in Section 443 Postal Laws and Regulations printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Heating and Ventilating Magazine Co., 1123 Broadway, New York, N. Y.
Editor, A. S. Armagnac, 1123 Broadway, New York, N. Y.
Managing Editor, None.
Business Manager, Gustave Petersen, 1123 Broadway, New York, N. Y.

2. That the owners are. (Give names and addresses of individual owners, or if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent or more of the total amount of stock.)

Heating and Ventilating Magazine Co., 1123 Broadway, New York, N. Y.
A. S. Armagnac, 1123 Broadway, New York, N. Y.
Gustave Petersen, 1123 Broadway, New York, N. Y.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are:

None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not apear upon the books of the company as trustee, hold stock and securities in a capacity other than that of a bona-fide owner and this affiant has no reason to believe that any other person, association or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

A. S. ARMAGNAC, Editor.

Sworn to and subscribed before me this 24th day of September, 1918.

A. C. Hagarty,
Notary Public, Kings County, No. 131.
Cert. filed in N. Y. County,
County Clerk's No. 316.
(My term expires March 30, 1920.)

EQUIVALENT INSIDE TEMPERATURE FOR DIRECT RADIATION.

The question is often raised as to what temperature would be maintained inside of a building with a direct heating system which would give 70° F. when it is zero outside or any other arbitrarily assumed temperatures. Table I covers this matter in an unusually complete form.

In using Table I the factor at the bottom of each column is of great importance being the ***number of degrees additional*** which will be realized in the *indoor* temperature for ***each degree*** the outside temperature is *above* the *specified* temperature.

Example:—A given job is specified to heat to 70° F. in zero weather with 5 lbs. steam on. At time of test it is 20° F. outside (average) and steam is at 3 lbs. What will the resultant inside temperature if the apparatus is large enough to fulfil the specified conditions?

The figures in Table I are the resulting temperatures with the outside at *zero* and the steam pressure varied. Thus, in the above case, if the outside were zero and the temperature inside 70° with 5 lbs. of steam, with 3 lbs., by the table, it would be 68.3° F. But with the outside temperature 20° above, the "factor" of 0.692 at the bottom of the column must be multiplied by 20 and this result *added* to the temperature *given by the table.*

Thus:— 0.692 x 20 =	13.84°	correction for outside 20°
	68.30	temperature for corrected steam pressure and zero
	82.14°	resultant inside temperature.

TABLE 1.

Actual Steam Pressure Under Test	Corresponding Steam Temperature	Steam Pressure To Be Used Under Specification. Pressure, Pounds Gauge.										
Vacuum In.	Degrees F.	0	1	2	3	4	5	6	7	8	9	10
10	192	63.3	62.3									
9	194.5	64.2	63.2	62.3								
8	197	65	64	63	62.2							
7	199	65.6	64.7	63.7	62.8	62						
6	201	66.3	65.3	64.3	63.4	62.6	62					
5	203	67	66	65	64	63.3	62.6	61.9				
4	205	67.6	66.6	65.6	64.7	63.9	63.2	62.5	61.7			
3	207	68.3	67.2	66.2	65.3	64.5	63.8	63.1	62.3	61.7		
2	208.5	68.8	67.7	66.7	65.7	65	64.2	63.6	62.8	62	61.5	
1	210.5	69.4	68.3	67.5	66.4	65.6	64.8	64.2	63.3	62.6	62.1	61.5
Gauge Lbs.												
0	212	70	68.8	67.8	66.9	66.1	65.3	64.6	63.8	63.1	62.6	62
1	215.5	71.2	70	69	68	67.2	66.3	65.8	65	64.2	63.7	63
2	218.7	72.1	71	70	69.2	68.2	67.3	66.7	65.9	65.1	64.5	64
3	221.7		72	71	70	69.2	68.3	67.6	66.7	66	65.4	64.8
4	224.5			71.8	70.8	70	69.2	68.4	67.5	66.7	66.2	65.7
5	227.2				71.7	70.8	70	69.2	68.3	67.6	67	66.3
6	229.8					71.7	70.8	70	69.2	68.4	67.7	67.2
7	232.4						71.7	70.9	70	69.2	68.6	68
8	234.9							71.7	70.8	70	69.3	68.7
9	237.3								71.5	70.5	70	69.3
10	239.4									71.3	70.7	70
Factors for each degree outside temperature varies from specified temperature		0.67	0.675	0.678	0.684	0.688	0.692	0.694	0.698	0.702	0.705	0.707

RULES FOR FLANGED FITTINGS.

AMERICAN 1915 STANDARD, EXTRA HEAVY.

1. Extra heavy reducing elbows carry same dimensions center to face as regular elbows of largest straight size.

2. Extra heavy tees, crosses and laterals, reducing on run only, carry same dimensions face to face as largest straight size.

3. Where long turn fittings are specified, it has reference only to elbows which are made in two center to face dimensions and to be known as elbows and long-turn elbows, the latter being used only when so specified.

4. Extra heavy fittings must be guaranteed for 250 lbs. working pressure, and each fitting must have some mark cast on it indicating the maker and guaranteed working steam pressure.

5. All extra heavy fittings and flanges to have a raised surface 1/16-in. high inside of bolt holes for gaskets. Thickness of flanges and center to face dimensions of fittings include this raised surfaced. Bolt holes to be ⅛-in. larger in diameter than bolts. Bolt holes to straddle center lines.

6. Size of all fittings scheduled indicates inside diameter of ports.

7. Square head bolts with hexagonal nuts are generally recommended for use.

8. Double branch elbows, side outlet elbows and side outlet tees, whether straight or reducing sizes, carry same dimensions center to face and face to face as regular tees and elbows.

9. Bull head tees or tees increasing on outlet, will have same center-to-face and face-to-face dimensions as a straight fitting of the size of the outlet.

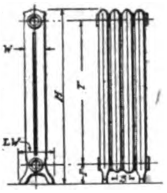
10. Tees, crosses and laterals 16-in. and smaller, reducing on the outlet, use the same dimensions as straight size of the larger port. Sizes 18-in. and larger, reducing on the outlet, are made in two lengths, depending on the size of the outlet as given in the table of dimensions.

11. For fittings reducing on the run only a long body pattern will be used. Y's are special and made to suit connections. Double branch elbows are not made reducing on the run.

12. Steel flanges, fittings and valves are recommended for superheated steam.

KEWANEE BOILER COMPANY'S 1-COLUMN KEWANEE RADIATORS FOR STEAM AND WATER.

		HEATING SURFACE, SQUARE FEET				
Number of Sections	Length, Inches	38 Inches High, 3 Square Feet per Section	32 Inches High, 2½ Square Feet per Section	26 Inches High, 2 Square Feet per Section	23 Inches High, 1⅔ Square Feet per Section	20 Inches High, 1½ Square Feet per Section
2	5	6	5	4	3⅓	3
3	7½	9	7½	6	5	4½
4	10	12	10	8	6⅔	6
5	12½	15	12½	10	8⅓	7½
6	15	18	15	12	10	9
7	17½	21	17½	14	11⅔	10½
8	20	24	20	16	13⅓	12
9	22½	27	22½	18	15	13½
10	25	30	25	20	16⅔	15
11	27½	33	27½	22	18⅓	16½
12	30	36	30	24	20	18
13	32½	39	32½	26	21⅔	19½
14	35	42	35	28	23⅓	21
15	37½	45	37½	30	25	22½
16	40	48	40	32	26⅔	24
17	42½	51	42½	34	28⅓	25½
18	45	54	45	36	30	27
19	47½	57	47½	38	31⅔	28½
20	50	60	50	40	33⅓	30
21	52½	63	52½	42	35	31½
22	55	66	55	44	36⅔	33
23	57½	69	57½	46	38⅓	34½
24	60	72	60	48	40	36
25	62½	75	62½	50	41⅔	37½
26	65	78	65	52	43⅓	39
27	67½	81	67½	54	45	40½
28	70	84	70	56	46⅔	42
29	72½	87	72½	58	48⅓	43½
30	75	90	75	60	50	45
31	77½	93	77½	62	51⅔	46½
32	80	96	80	64	53⅓	48



Note—Add 1/2 in. for each bushing to get total length of radiator.
H — Total overall height.
T — C. to C. of tappings.
F — Floor to center of bottom tapping.
W — Width of radiator—4 1/2 in.
LW — Width of radiator legs—4 1/2 in.
S — Width of radiator sections—i. e., c. to c. of sections, or 2 1/2 in.

Nominal Height of Radiator In.	Actual Height H In.	For one-pipe steam and return on two-pipe steam F In.	T In.	For two-pipe steam supply and hot water supply and return F In.	T In.
38	38	4	31 1/2	4 1/2	31
32	32	4	25 1/2	4 1/2	25
26	26	4	19 1/2	4 1/2	19
23	23	4	16 1/2	4 1/2	16
20	20	4	13 1/2	4 1/2	13

For high legs add 1 1/2 in. to H. and F.
For legless radiators deduct 2 1/4 in. from H. and F.

TAPPING DATA

All radiators are regularly tapped 1 1/2 in. and bushed as follows:

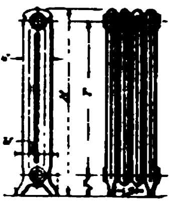
When top tapping is required it can be furnished either 1 1/2 in. and bushed or tapped solid any size smaller than 1 1/2 in.

SYSTEM	Size of Radiator Square Feet	Supply In. Diam.	Return In. Diam.
Steam, one-pipe	Up to 24, inc.	1	
	Over 24 up to 60 inc.	1 1/4	
	Over 60 up to 100 inc.	1 1/2	
	Over 100	2	
Steam, two-pipe	Up to 48 inc.	1	3/4
	Over 48 up to 96, inc.	1 1/4	1
	Over 96	1 1/2	1 1/4
Water	Up to 42, inc.	1	1
	Over 42 up to 72, inc.	1 1/4	1 1/4
	Over 72	1 1/2	1 1/2

Air valve tappings are 1/8 in.
Vapor tappings are special.
All tappings with R. H. threads.

KEWANEE BOILER COMPANY'S 2-COLUMN KEWANEE RADIATORS FOR STEAM AND WATER

		Heating Surface Square Feet					
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	5	[illegible]	8	6	[illegible]	4	4
3	[illegible]	[illegible]	12	[illegible]	8	[illegible]	[illegible]
4	[illegible]	20	16	[illegible]	[illegible]	[illegible]	8
5	[illegible]	25	20	[illegible]	[illegible]	[illegible]	[illegible]
6	[illegible]	30	24	[illegible]	[illegible]	[illegible]	[illegible]
7	[illegible]	35	28	[illegible]	[illegible]	[illegible]	[illegible]
8	[illegible]	40	32	[illegible]	[illegible]	[illegible]	[illegible]
9	[illegible]	45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	[illegible]	50	40	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	55	44	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	30	60	48	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	65	52	[illegible]	[illegible]	[illegible]	[illegible]
14	[illegible]	70	56	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	75	60	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	80	64	[illegible]	[illegible]	[illegible]	[illegible]
17	[illegible]	85	68	[illegible]	[illegible]	[illegible]	34
18	[illegible]	90	72	[illegible]	[illegible]	[illegible]	36
[illegible]	[illegible]	95	76	[illegible]	[illegible]	44	38
20	[illegible]	100	[illegible]	[illegible]	[illegible]	46	40
21	[illegible]	[illegible]	84	[illegible]	56	[illegible]	42
[illegible]	[illegible]	[illegible]	88	[illegible]	58	[illegible]	44
23	[illegible]	[illegible]	92	[illegible]	[illegible]	[illegible]	46
24	[illegible]	[illegible]	96	[illegible]	64	56	48
25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	50
26	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	52
27	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	63	54
28	70	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	56
29	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
31	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
32	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]



Note—Add 1/2 in. for each bushing to get total length of radiator.
H — Total overall height.
T — C. to C. of tappings.
F — Floor to center of bottom tappings.
W — Width of radiator—7 1/2 in.
LW — Width of radiator legs—7 1/2 in.
S — Width of radiator sections—i. e., c. to c. of sections, or 2 1/2 in.

Nominal Height of Radiator In.	Actual Height H In.	For one-pipe steam and return on two-pipe steam F In.	T In.	For two-pipe steam supply and hot water supply and return F In.	T In.
45	45	4	38 1/2	4 1/2	38
38	38	4	31 1/2	4 1/2	31
32	32	4	25 1/2	4 1/2	25
26	26	4	19 1/2	4 1/2	19
23	23	4	16 1/2	4 1/2	16
20	20	4	13 1/2	4 1/2	13

For high legs add 1 1/2 in. to H. and F.
For legless radiators deduct 2 1/4 in. from H. and F.

TAPPING DATA

All radiators are regularly tapped 2 in. and bushed as follows:

When top tapping is required it can be furnished either 1 1/2 in. and bushed or tapped solid any size smaller than 1 1/2 in.

SYSTEM	Size of Radiator Square Feet	Supply In. Diam.	Return In. Diam.
Steam, one-pipe	Up to 24 inc.	1	
	Over 24, up to 60, inc.	1 1/4	
	Over 60 up to 100, inc.	2 1/2	
	Over 100.		
Steam, two-pipe	Up to 48, inc.	1	3/4
	Over 48 up to 96, inc.	1 1/4	1
	Over 96.	1 1/2	1 1/4
Water	Up to 42, inc.	1	1
	Over 42 up to 72, inc.	1 1/4	1 1/4
	Over 72	1 1/2	1 1/2

Air valve tappings are 1/8 in.
Vapor tappings are special.
All tappings with R. H. threads.

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AIR SUPPLY FOR A LARGE GENERAL OFFICE BUILDING

Past and Present Practice Illustrated in Remarkable System Installed for Swift & Co., Chicago

By SAMUEL R. LEWIS

A better understanding of the plant and the reasons for an unusual design will be gained by a brief description of the old plant which cared for the original building.

The general office building of Swift & Company, as it existed prior to the summer of 1917, was five stories high, about 200 ft. long and 94 ft. wide. It was equipped with an indirect system of heating, using live steam, with electric power. Fresh air was taken through the sides of a roof pent house, drawn through tempering heaters in

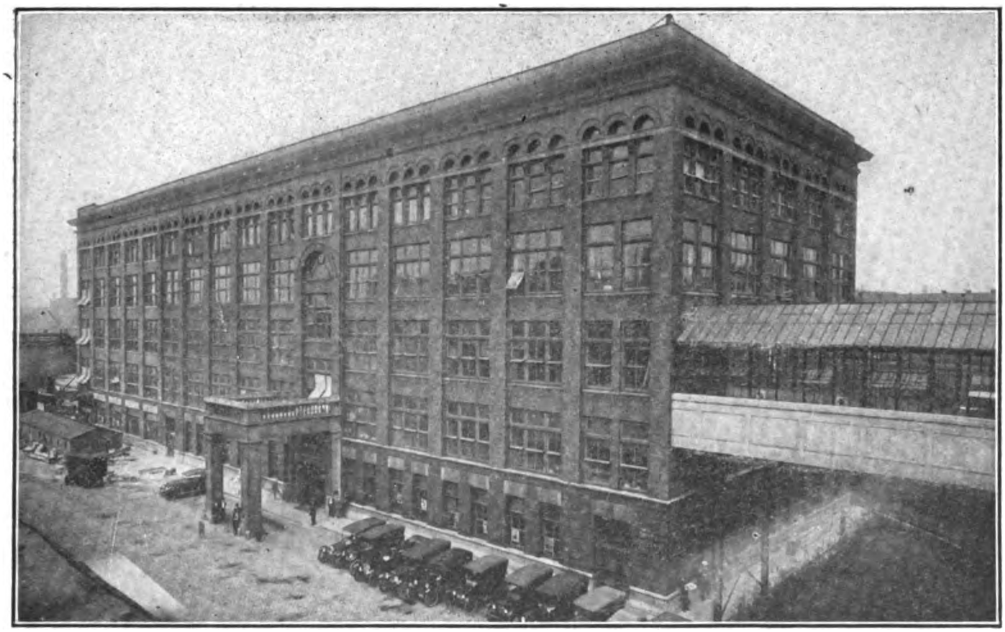


FIG. 1.—GENERAL OFFICE BUILDING, SWIFT & CO., CHICAGO.
The original building comprised the eleven southerly panels, the five panels to the extreme left are the addition. The covered bridge on the right is a private connection with the elevated station.

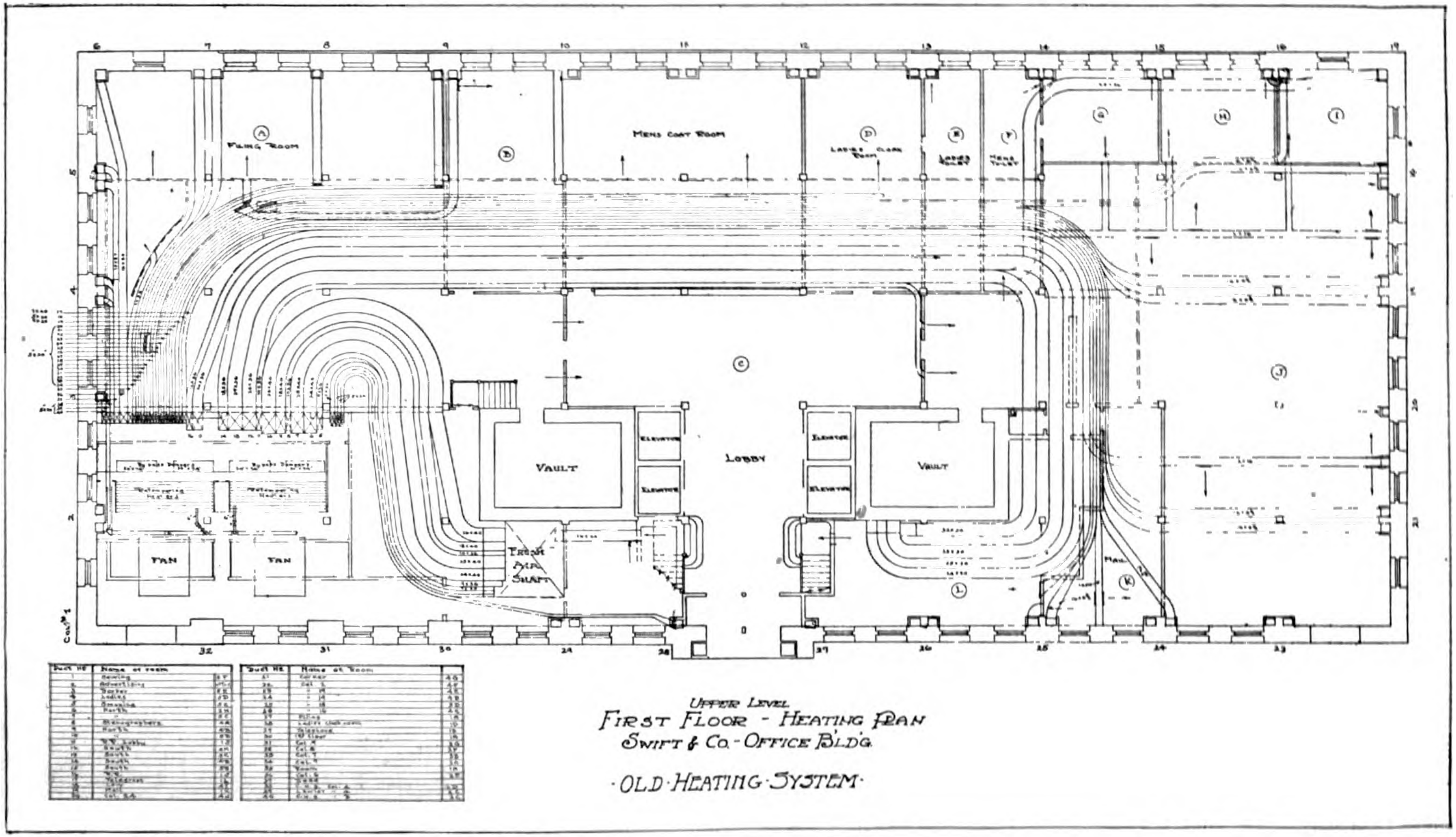


FIG. 2.—FIRST FLOOR PLAN OF THE OLD VENTILATING SYSTEM.

The fresh air passed from the intake shaft over the elevator machinery and through the air washers in a pit under the retempering heaters, then to the four inlets to the two supply fans. Leaving the fans, it was delivered through the ceiling ducts, the size and extent of which may be partially realised from the drawing.

the attic, then down a tortuous and constricted passage to the basement.

Here, as originally designed (Fig. 2), the fans delivered it through reheaters into a large hot air plenum chamber, or by-passed it under the reheaters to adjacent tempered air plenum chamber. From these pressure rooms, which were located in the northwest corner of the basement, as shown on the drawing, a separate metal duct conveyed the air to the bottom of each vertical flue. In general there were two supply flues to each story, and these were located symmetrically near the center of the building, serving the general open spaces. There were, however, a number of private offices, and separate flues to supply these ran up the outside walls. Each separate duct had a mixing damper at the plenum chamber in the basement controlled by a thermostat in each room. The ducts in some cases were over 200 ft. long, only 5 in. wide, and 20 in. deep. They were concealed above the first story ceiling.

DEFECTS OF PREVIOUS SYSTEM.

There was no direct radiation anywhere in the building, except in the front entrance. The toilet rooms had no heating or ventilating facilities whatever; such air and warmth as they gained leaked in through the doors.

The delivery of fresh air in the general offices on the second, third and fourth floors was near the ceiling from an interior wall toward the windows. The exhaust arrangements consisted of tile-lined vent flues about 10 in. x 16 in. inside, against the outside walls. The total cross-sectional area of the vent flues in any rooms was usually very much less than the area of the supply flues, and the aggregate area of all of the facilities available for air removal was far less than that which experience has proven necessary. The fresh air tended to pass from the high-up interior supply openings over the heads and above the breathing zone level of the occupants, to the cool outside walls and glass. Here it would fall toward the floor, passing directly out through the vent openings, chilling the unfortunate people adjacent to such openings and resulting in the openings, despite strenuous efforts to prevent it, being closed every cold morning. The center of the room, in the meantime, received practically none of the entering fresh air.

NECESSITY FOR CLEANING AND COOLING AIR.

As the company grew and the intensity of occupation mounted, it became apparent that in order to maintain efficiency some means of cleaning and cooling the air must be provided. Accordingly a space under the plenum chamber was excavated and the fresh air en route from the tempering heaters to the fan was passed through a water spray, then through a cast-iron eliminator. This old washer, due especially to the high air velocity through it and the inefficient eliminator, was unsatisfactory either as a cleaner or as a remover of entrained water. A concrete tank was excavated for, below the floor, and this tank was filled with brine coils which were entirely submerged in the circulating water. As a cooler, due to practically unlimited refrigeration, the old plant was competent.

The first floor was originally intended to be used for storage purposes, and the ventilation of the crowded rooms installed here as a makeshift was most unsatisfactory. There were no adequate supply ducts, no vent flues, and the principal ventilation of this floor was via the stair hall to the attic. The fifth floor was designed as a dining-room with ceiling inlets and outlets alternating around the various chandeliers. All supply ducts for the fifth floor were run through an attic space between the trusses, about 5 ft. high, under a flat concrete roof. This attic gets very cold in winter, and extremely hot in summer. Although the old attic ducts were insulated, the losses were considerable, especially in winter, when the entire heating was done by air which, after being warmed, had traveled in some cases as far as 600 ft. through narrow metal ducts.

All windows were double, this being necessary to prevent frosting in winter and undue losses in summer, but the entrance doors were leaky and of the swing type. Consequently, when cooling, the conditioned air, being much heavier than the warm outside air, fell down the stairs and ran out of the doors acting like so much water. All condensation from the heating system was wasted to the sewer. The long exposure of adjacent, very narrow and deep metal ducts to each other made temparature control of distant rooms very difficult.

EXPOSED STEEL AT STOCKYARDS SUBJECT TO RAPID CORROSION.

Some substance in the air at the stockyards, popularly believed to emanate from sulphuric acid processes, causes very rapid corrosion of all exposed steel. Ordinary black steel pipe heaters and even galvanized steel sheets have a very short life. The old tempering heaters had been renewed several times, and the fan housings had been patched repeatedly to cover holes caused by corrosion. The air is also heavily charged with dust and soot. The old air-ways, with their long, horizontal runs of inaccesible space, were thoroughly coated with this matter, which could not be reached, but which accumulated year by year.

HOW DUST IN AIR DUCTS NULLIFIES WORK OF AIR WASHER.

In this connection it is interesting to observe that while careful tests of very efficient air washers show that they may and do reduce the bacteria content very materially, samples taken from points in duct systems only slightly distant show large numbers of colonies. Conditions in air ducts as to moisture and temperature are favorable to the development of bacteria, and we draw the conclusions that the nearly sterile air from the washer is rapidly impregnated with spores from the air-way surfaces and that we would do well to have these surfaces accessible, and to see that they are cleaned frequently.

ENTIRELY NEW SYSTEM DESIGNED FOR ENLARGED BUILDING

It was decided by Swift & Company in 1917, to increase the size of the building about 50%, adding five stories on the north end, about 90 ft. by 94 ft. in area.

The considerations mentioned in connection with the old ventilating plant—that it was overloaded, and that it occupied valuable and well-lighted space on the first floor—made it desirable to install an entirely new system for the entire building.

During the winter of 1916-17, fortunately, we had made an investigation and report on the old system and so were familiar with all of its details. In designing the new plant, some of the vital considerations were:

1. The plant must be efficient as a cooling system as well as for heating, since the large floor areas in proportion to outside wall heavy percentage of occupancy and extensive use of electric lights render cooling in warm weather imperative.
2. There must be control of humidity at all times, whether heating or cooling.
3. The maximum of accessibility to all parts for cleaning must be provided, since the plant runs 24 hours per day, the year round.
4. A minimum use of steel in any form must be achieved, to avoid the heavy maintenance expense due to corrosion.
5. Exhaust steam, an ample quantity of which is available, must be used for heating, rather than live steam.
6. The ventilation of the toilets and wardrobes must be positive.

7. All plumbing must be protected by adequate radiation to prevent freezing when the fan sytem, for any reason, is shut down.

8. Since there is to be a dining-room on the fifth. floor and a caféteria on the first floor, care must be used to prevent any odors of food in the offices.

9. There are not only large general offices, but also, around them, on the outside walls, many private offices and the location and size of these private offices will inevitably from time to time be changed. It is necessary to provide separate heating, cooling, ventilation and temperature control of these offices, arranged so flexible as to permit of changes being made at any future date, and when such changes are made the conditions must be equally good in all offices, old and new.

10. The plant must be designed so that the fresh air sweeps all of the floor area, with reasonably even speed, and so that even though private offices extend around a large percentage of the exterior walls, cutting off the vent flues, the general offices shall not suffer thereby.

11. The plant must be designed so that the continuous operation of the building shall not be interfered with while the new plant is being installed, and so that service shall be furnished by one or the other plant at all times during the reconstruction.

LOOP CIRCUITS FOR THE AIR PROVIDED FOR IN GENERAL SCHEME.

The best ventilation we know of is obtained by a current of comfortably heated and moistened air sweeping like a breeze across the bodies of the occupants. Structural limitations and physical conditions of local heating and cooling which would disturb such a current render its use on any grand scale impracticable in this building. In rooms having fixed seats we can simulate this desirable condition by using floor inlets, as in theatres and churches. Here, however, absolute flexibility of furniture locations is imperative. The modified system of cross ventilation of the old plant has been proven unsatisfactory, as we found certain places in the large rooms, near the center, with carbon dioxide content as high as 17 parts per 10,000, showing that practically none of the entering air reached these spots. We, therefore, adopted a general scheme of loop circuits for the air, with inlets usually well above the breathing zone, having a velocity of around 600 lin. ft. per minute, and outlets at both floor and ceiling, the outlets being distributed as far as practicable so as to drain out the air from all parts of every room. Where the outlets cannot be depended upon to do this, the inlets may do so by high velocity jets of air sprayed over the heads of the occupants and reaching the stagnant parts. All inlets, therefore, have adjustable diffusers capable of diverting the air horizontally, and many inlets have horizontal adjustable louvers in addition, for vertical diversion of the air currents. In adjusting the air delivery since putting the plant into commission, we have found these diffusers of remarkable value. Necessarily in so crowded a room there may be conditions affecting a few occupants who must sit very close to vent openings, due to drafts. In such cases opening the vent registers at the ceilings or setting them partly open will settle the problem, without curtailing the general ventilation.

When cooling the room, the heavier chilled air from the inlets falls to the floor, displacing the warmer and contaminated air. At such times the upper outlet openings are most effective in promoting good ventilation.

A considerable supply of air was provided in excess of the capacity of the regular outlet flues, and this excess is used for supply to wardrobes, toilets, etc., also to provide a movement of air from all floors out into the corridors and stair halls, and from these into the dining-room, caféteria, etc., so as to prevent dissemination of food odors.

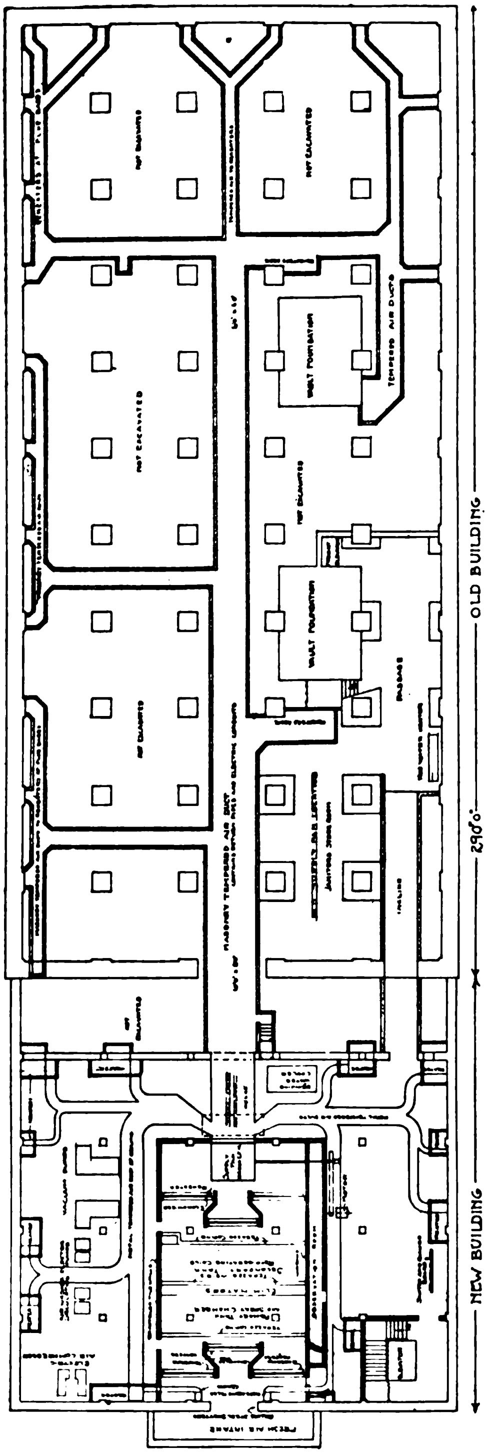


FIG. 3.—BASEMENT PLAN OF THE NEW VENTILATING SYSTEM.

The basement extends under the new part of the building only. Tunnels for airways were excavated under the old part.

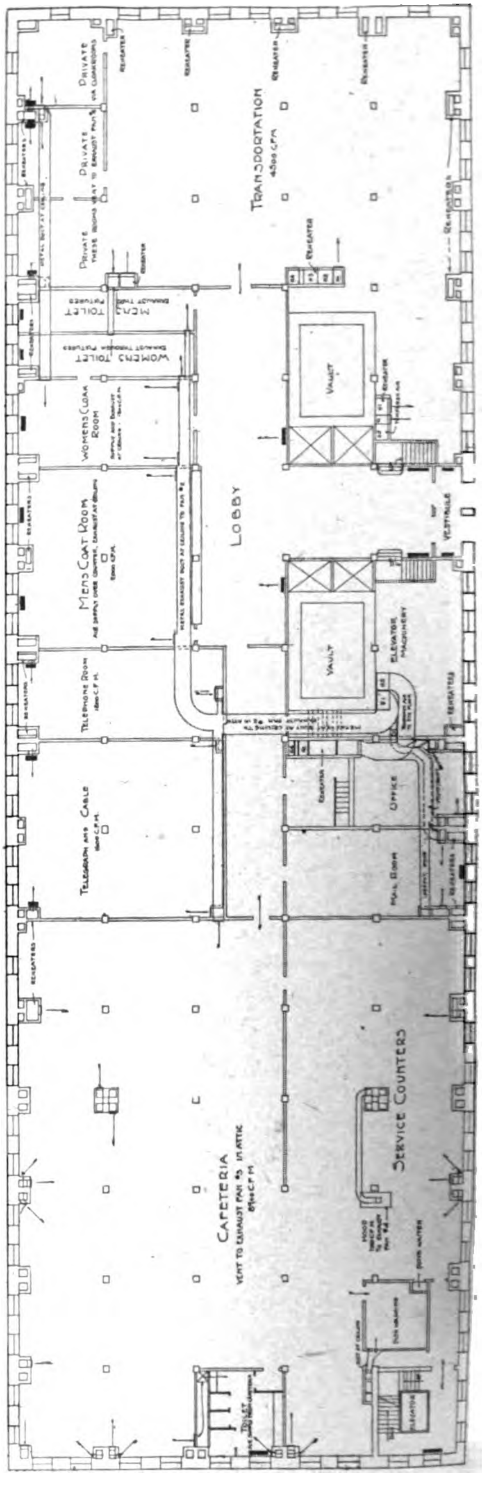


FIG. 5.—PLAN OF FIRST FLOOR, SWIFT & CO. BUILDING.

In the old part at the right will be seen the enlarged flue bases enclosing the reheaters. In the center will be noted the exhaust ducts for toilet, locker rooms, etc.

ARRANGEMENT OF AIR-WAYS IN NEW SYSTEM.

The new tempered air duct runs down the center of the building (Fig. 3) with small branches to the risers, and is in tunnel under the old part, and in metal in the new part, a basement existing under the new part only. All ducts for air supply, however, are large enough for easy passage of a man, and the main air-ways would take an automobile.

Since the air in the main masonry duct is never cooler than about 60° F or warmer than about 66° the year round, there is no special insulation required after once bringing the walls and surrounding ground to this temperature. The metal supply ducts, however, in the basement are heavily insulated; more on account of the objectionable dripping from them than for any other reason. (The ducts are usually much cooler than the warm damp basement.) The metal supply ducts in the attic also are insulated because the attic is very hot in summer and very cold in winter.

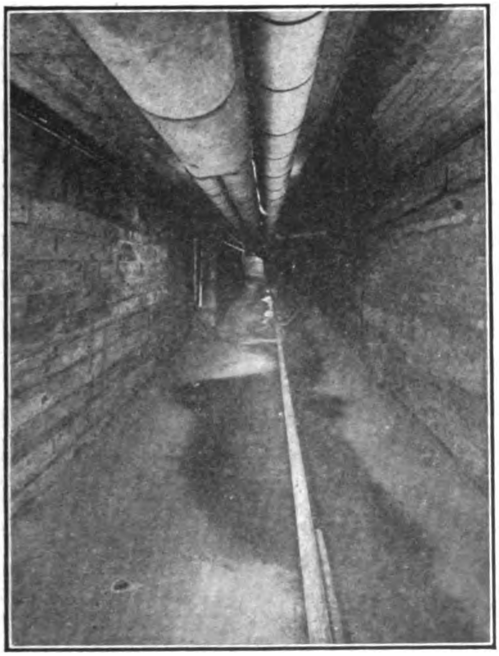


FIG. 4.—INTERIOR OF THE MAIN TEMPERED AIR DUCT.

Covered steam pipes and electric conduits will be noted at the ceiling. The pipe at the floor is a vacuum return. The bottoms of all tunnels are well above the basement of the new building, toward which they grade. The tunnels are, therefore, perfectly dry, except when washed out for sanitary reasons.

The main air-ways are provided with lights (Fig. 4) with adequate cleaning facilities, and serve also as conduits for steam, water, compressed air and other pipes, all of which, of course, are properly covered.

By this general scheme in which only the old vertical flues are used by both old and new plants, it was possible to keep the old plant running until the new one was completely installed so far as the new third of the building was concerned (Fig. 5); then to build the new underground work in the old part so that air from both sources was available at every flue; changing a flue at a time from old to new supply system until enough had been changed to permit of the removal of the old apparatus.

The following is a schedule of the fans, which are of the Sturtevant multivane type:

No. 1. Supply, 104,000 C. F. M.

No. 2. Exhaust toilets and lockers, 24,700 C. F. M.

No. 3. Exhaust dining-room and caféteria, 16,300 C. F. M.

No. 4. Exhaust kitchen, 6,000 C. F. M.

In order to economize on floor area, which is extremely valuable, the fresh air intake is from the north and a little above the ground, and all exhaust fans are in the attic—thus there are no down current air-ways, but all passage of air is upward.

HOW THE PRIVATE OFFICES WERE HANDLED.

The problem of the ever changing private offices is cared for by providing at each outside wall panel point in each room:

A. Adequate steam supply and vacuum return risers.

B. Compressed air risers for automatic control.

C. A vent flue which can be tapped as required.

D. A tempered air supply flue which can be tapped as required.

Any private office, therefore, may take from the main tempered air riser (capable of supplying as much as 2000 cu. ft. of air per minute) the 400 cu. ft. likely to be the maxim needed, and may return this air to the corresponding vent flue. An enclosed raidator is provided for each office, which warms the tempered air as needed to maintain the desired temperature, depending on outside conditions (Fig. 6). When a private office is removed, throwing the space into the general office, the separate heating and ventilating arrangements may be removed or not, as convenience dictates.

Experience has shown that when under full occupancy of the general offices (Figs. 7 and 9), with many lights turned on, we must have the tempered air cooled as low as 60° in summer. Such an inlet temperature

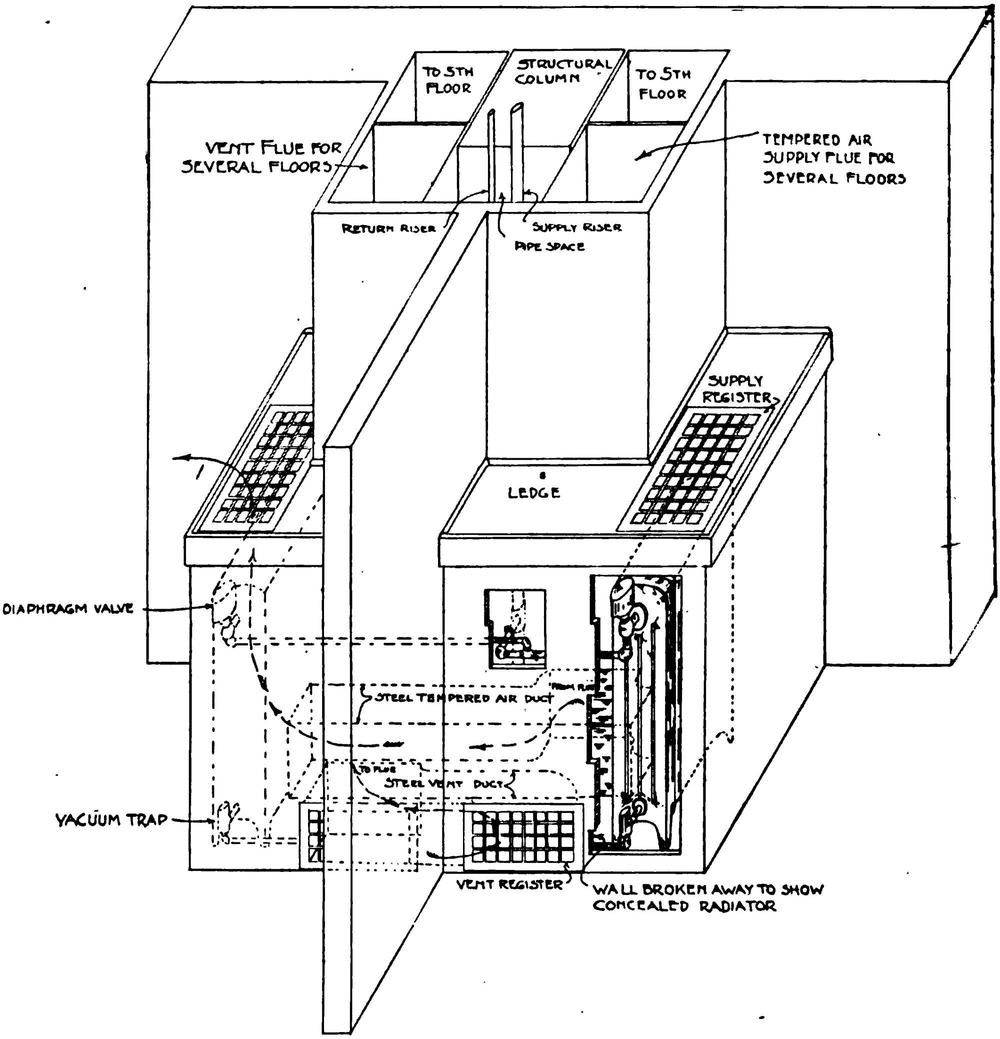


FIG. 6.—FLEXIBLE ARRANGEMENT OF FLUES FOR PRIVATE OFFICES.
In certain locations flues as illustrated are provided, which permit private offices in each panel, at any or all floors, each office to have a radiator, warm or cool air supply, a vent flue and a thermostat.

will not answer at all for the private offices with their limited number of occupants, so it is common practice in this building even in hot weather to have the steam turned on the radiators in the private offices and smaller rooms. There seems no way to avoid the necessity of doing this, especially in the rooms which do not receive the warm sunshine.

The exhaust fans care for the removal of about 46,000 cu. ft. of air per minute, the remainder, 58,000 cu. ft. of air per minute, escaping through roof ventilators from the attic, induced by the pressure generated by the supply fan (Fig. 10).

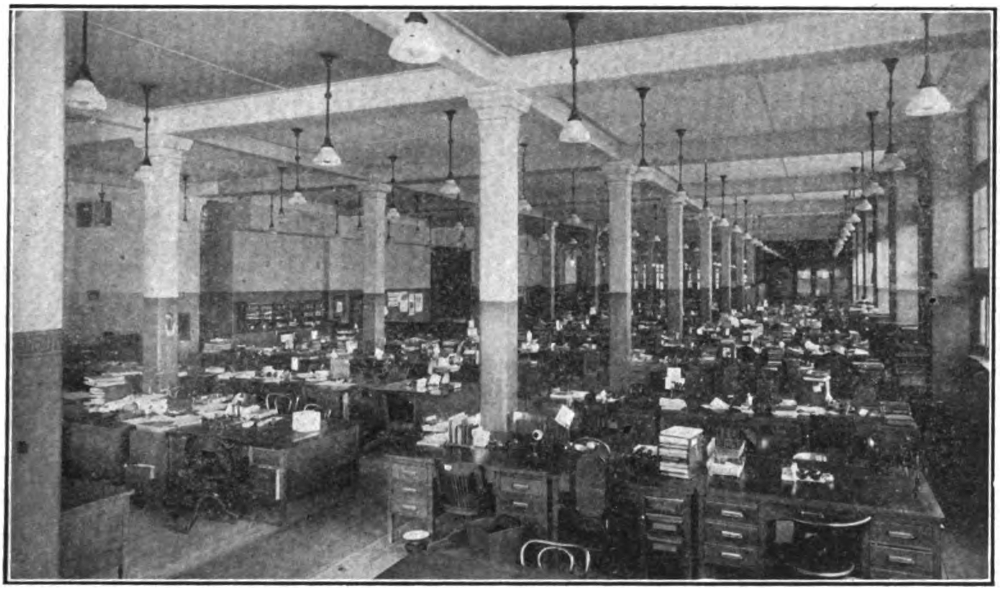


FIG 7.—VIEW IN GENERAL OFFICES, SWIFT & CO. BUILDING.

In general, the inlets and outlets are in the faces of the piers shown at the right. A large diffuser, however, may be seen at the upper left corner.

REASONS FOR NOT RECIRCULATING THE AIR.

There was no provision made for recirculating any of the air, even when cooling, for the following reasons:

It has by no means been demonstrated that any air washer will remove the objectionable conditions from air which has been breathed, or that an air washer will restore the desirable vitality to the air.

In this plant the mental activity and physical welfare of the occupants are of first importance, and operating costs are of little relative importance.

The value of floor space and sunshine are so high that the flues necessary for recirculation would be inordinately expensive.

We have the stockyards odors, of rendering, fertilizer works, etc., to contend with, and their amelioration is considered a sufficient burden without adding any human element.

The owner knows that it is the best of investments for him to promote the most healthful and comfortable working conditions in this building. The occupants and even casual visitors have very little realization of the extent of the physical equipment involved in such promotion. Therefore, we arranged for especially easy access to this plant, with plenty of light, white enameled walls, a special observation room with windows for the air washer, etc.

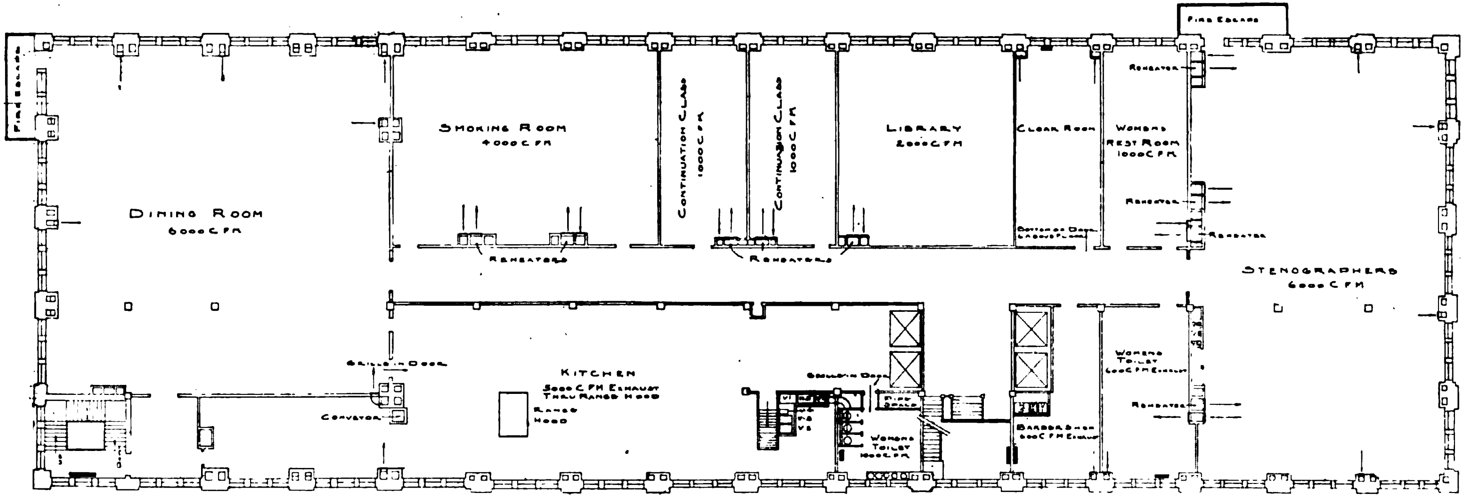


FIG. 8.—PLAN OF THIRD FLOOR, SWIFT & CO. BUILDING.

The toilet and coat rooms have mechanical exhaust, the considerable volume of air removed from them being drawn from the general offices. At the right will be seen the bridge leading to the elevated station.

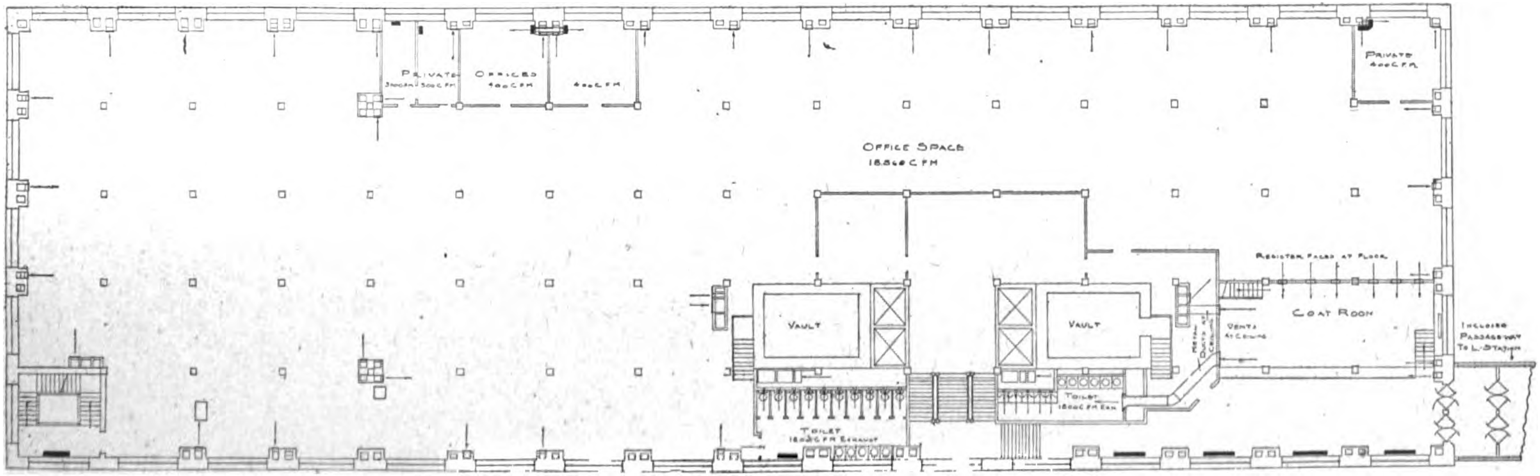


FIG. 9—PLAN OF FIFTH FLOOR, SWIFT & CO. BUILDING.

All air supply to the old part of this floor on account of exigencies of construction, passes across the attic to the various flue locations, then down to the floor and up through the individual reheaters, forming an air lock, so that the reheaters will supply the rooms naturally. The dining room and smoking room are provided with exhaust fan connections while a still greater suction is maintained by the separate kitchen exhaust fan, so that by no chance can [illegible] general building.

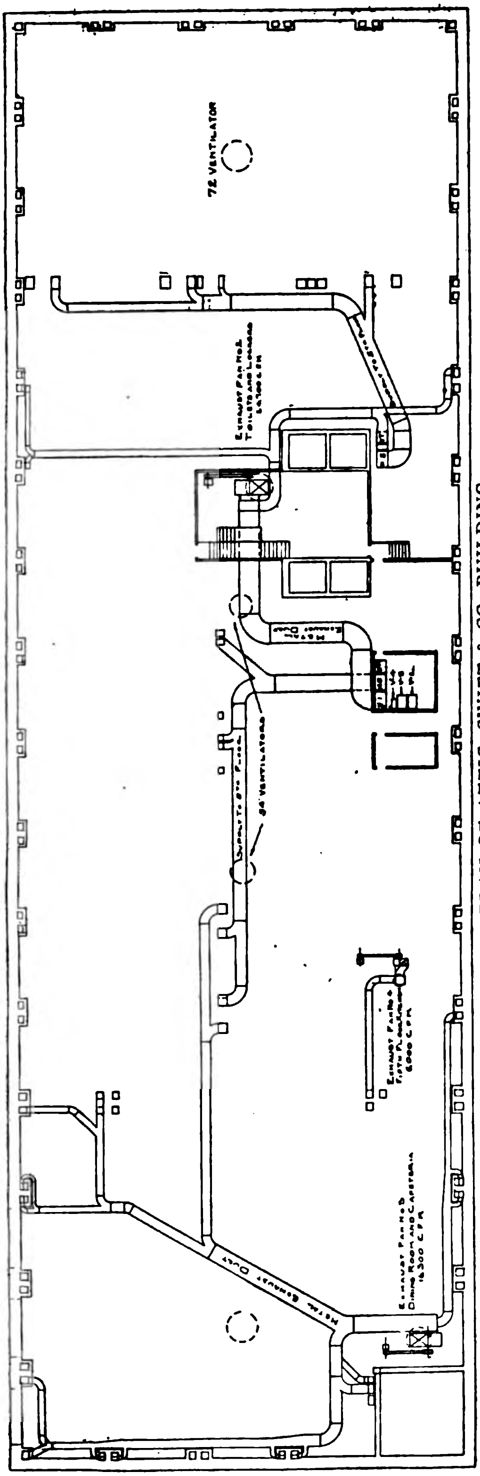


FIG. 10.—PLAN OF ATTIC, SWIFT & CO. BUILDING.

Here are shown the various exhaust fans and ducts, also the ducts which supply air to the offices on the fifth floor. Steam supply mains, not shown on this plan, reach all of the down-feed risers.

DETAILS OF EQUIPMENT.

The air supply comes from the north from a hooded inlet a few feet above grade. This is not the most favorable point for clean air in our judgment, and we hope may later be improved. The use of this inlet at present is governed by expediency.

The fresh air passes first two 9-in. layers of cast-iron Vento heater, encased in enameled brick, not sheet steel, and controlled by a thermostat to prevent freezing the washer. Then the washer is passed, with its influence, as may be, for cooling or heating, drying or moistening the air; then an additional Vento heater, called the economizer, warming the air to the required tempered air duct point, using water of condensation discharged by the vacuum pumps. If this coil is insufficient there is an additional steam-supplied heater coil beyond it, which will be in effect if necessary, as demanded by the duct thermostat.

The air washer is called upon merely to remove as much as possible of the dust and soot, to cool the air in summer, using water which has been chilled by refrigeration, and to introduce moisture in the winter, using water which has been warmed by steam injection. The air washer, as well as the other air-handling equipment, was designed particularly to promote durability and ease of cleaning to the fullest possible extent. There is a reinforced concrete washer tank lined with enameled brick. At the tank waterline, at the inlet to the washer, is a galvanized steel header, from which rise the supply pipes carying Braemer Air Conditioning Company's phosphor-bronze spray nozzles. (Fig. 11). The walls and ceiling are impervious to moisture, and a wide passage across the front of the washer gives access to the sprays. The eliminators, also of Braemer make, are set above the tank, on enameled brick piers, and are built in units, any group of which is easily removable. They are accessible for

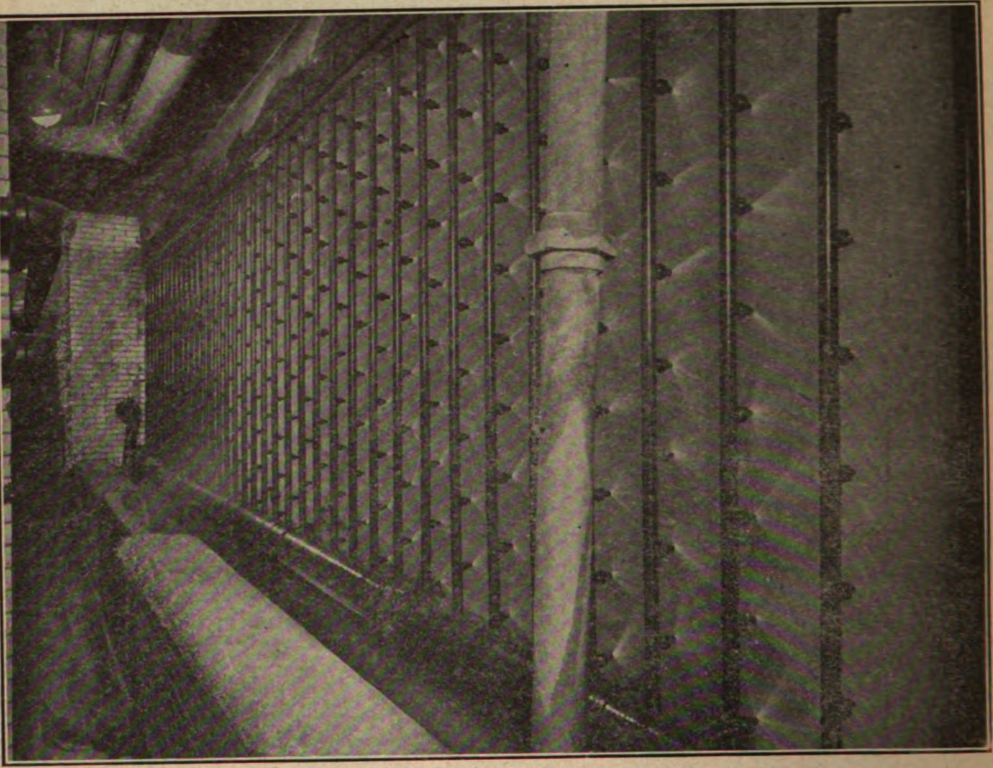


FIG. 11.—SPRAY CHAMBER OF AIR WASHER.

To the left are the primary tempering heaters, to warm the entering fresh air above freezing. The air passes the nozzles from left to right. The spray chamber is 30 ft. long.

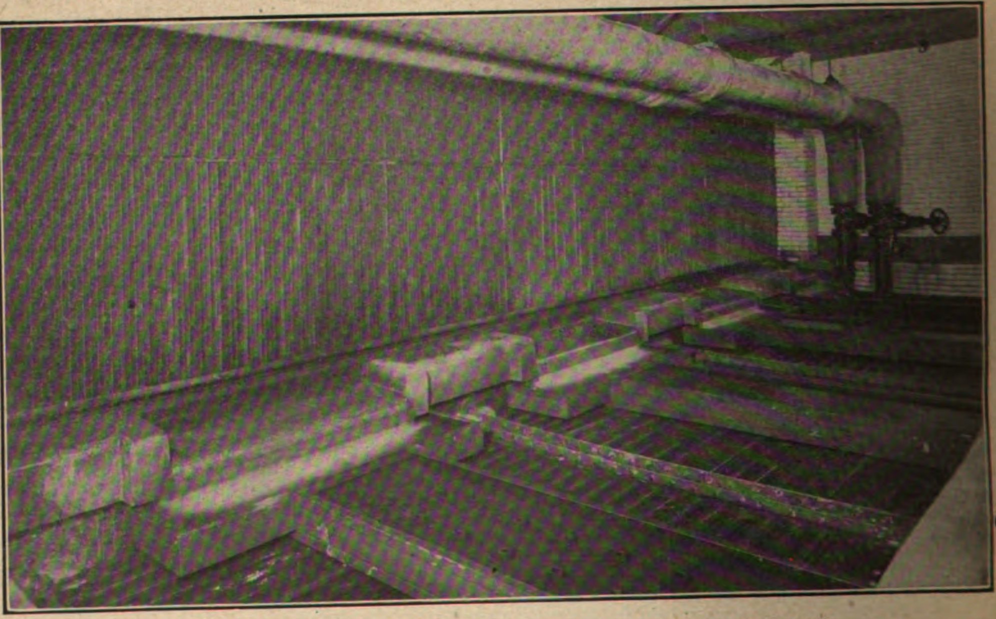


FIG. 12.—ELIMINATORS, DISTRIBUTORS AND BAUDELOT COILS.

The air, having been washed and otherwise conditioned at the spray chamber, passes through the eliminators shown at the left, on its way to the fan. In winter, ordinarily it is unnecessary to cool the spray water, but it is necessary to warm it, and under such conditions no water flows over the four weirs shown here, and the refrigeration is shut off. In summer, however, the water must be chilled, by contact with brine coils. It flows downward in droplets over the cold pipes, from the distributors shown in the center. The covered pipes overhead are the brine mains.

cleaning from both front and back, and instead of being encased in steel, as is usual, are in a masonry enclosure. They have flooding nozzles. The washer tank has a sewer connection for flushing out, an automatic overflow, and a connection to the pump suction.

There is a larger and much deeper tank beyond the regular washer tank (Fig. 12), also lined with enameled brick, and containing 6,000 sq. ft. of surface of 2 in. galvanized-steel brine coils. When the cooling function is in effect the first or regular tank overflows via concrete weirs to standard Baudelot distributors, the comparatively warm water trickling down over the refrigerating coils to a cool pool below, from which a connection is made to the pump suction.

The circulating pumps (Fig. 13) are each 6 in., direct-connected electric centrifugals, in duplicate.

In winter only the regular tank need be used, the cool tank and Baudelot coils being drained. Humidity control is then established by warming the water as needed, by an injector.

In summer the circulating pump draws from the regular tank or from the cool tank as humidity conditions require, suction from either as desired being achieved by diaphragm valves in both connections.

The equipment is arranged to maintain not more than 80° inside with 60% relative humidity when the outside temperature is not higher than 95° and 48% relative humidity; and to maintain at least 70° inside with at least 60% relative humidity with the air entering the washer at 40°.

This equipment conditions the air to the extent used for cooling, somewhere around 60°, and in this condition all horizontal transmission through the airways to the bases of the flues, is effected. At the flue bases are reheaters (Fig. 14), the steam supply to which is controlled by the thermostats in the rooms. If the rooms are too warm, the tempered air is delivered; if they are too cool, steam is admitted to the reheaters as required.

Distilled water is used for drinking purposes, and this water is cooled and circulated continuously by a pair of duplicate centrifugal pumps. A ther-

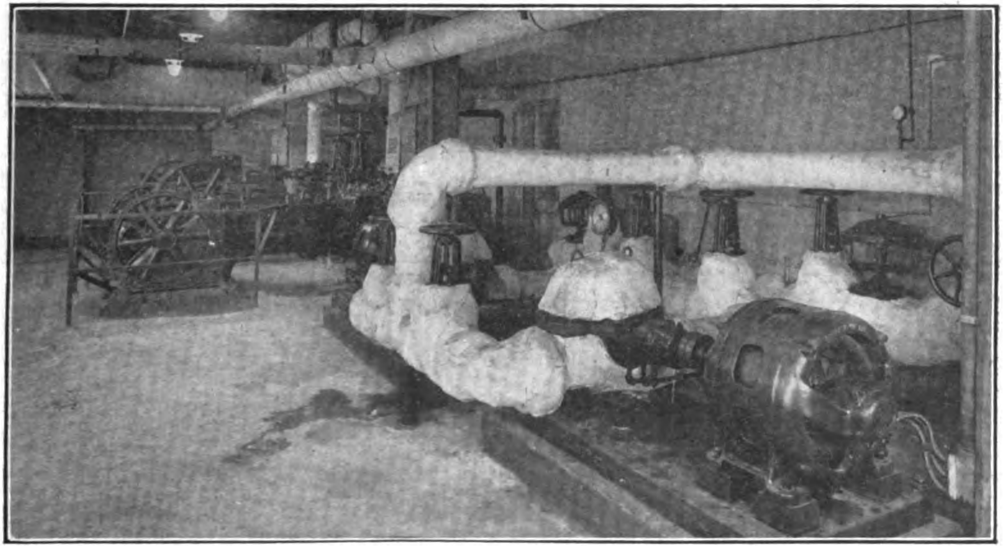


FIG. 13.—CIRCULATING PUMPS FOR AIR WASHER.

These 6-in. pumps are in duplicate so that one always is in reserve, and are used to force the water through the sprays. As humidity conditions in the building require, the temperature of the spray water is varied automatically, the diaphragm valves which aid this function being shown at the rear. One of the heavily covered tempered air ducts may be seen overhead.

mostat controls two diaphragm valves, arranged so that the mixture of chilled and normal water may be maintained at the most satisfactory point.

The dining-room on the fifth floor and caféteria on the first floor (Fig. 17), while they serve others besides employees of this office, and the bulk of their business here. It is not necessary to ventilate them to full capacity except near and during meal times. Therefore, pneumatic switches and dampers are provided which permit the operating engineer to cut off the air to and from either the dining-room, or the caféteria or the smoking room, or all of them, as desired, compelling the maximum air movement reasonably to follow the maximum occupancy.

The kitchen has a separate and powerful exhaust through the hoods over the ranges and kettles and this fan is in operation nearly all the time. A strong current of air is thus maintained from the dining-room through the doors, and from the caféteria via the conveyor, into the kitchen, tending to cool the latter as well as preventing dissemination of odors.

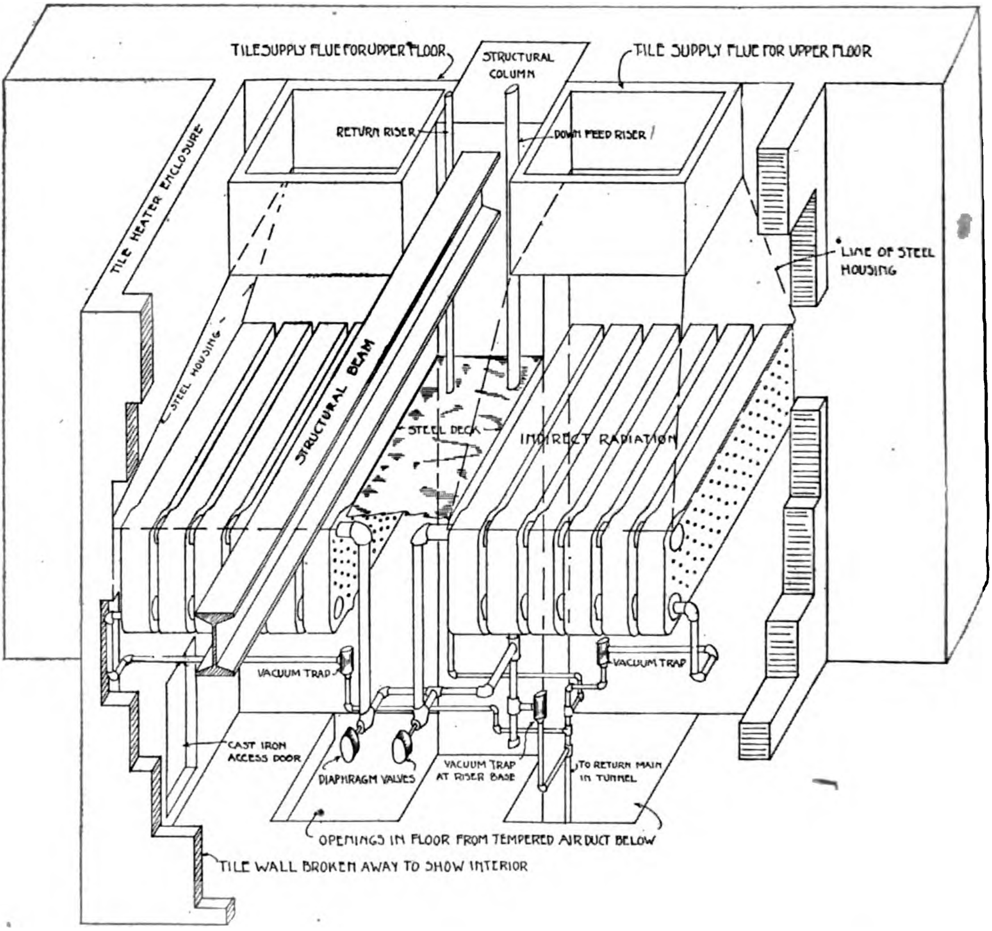


FIG. 14.—TYPICAL ARRANGEMENT OF INDIRECT HEATERS AT FLUES.

Only tempered air is conveyed horizontally, this air being heated further as needed by indirect heaters at the flue bases. These are in the basement in the new part, and in the first floor in the old part. This arrangement permits all diaphragm valves and vacuum traps to be accessible, while entirely concealed. Cast-iron access doors are provided.

Similar pneumatic operation is provided for all foul air outlets; and so that when desired for quick heating, the full force of the tempering heaters may be used, regardless of automatic temperature regulation.

The steam circulation for heating is at atmosphere or lower, using exhaust steam. Each unit of surface has a thermostatic vacuum trap. The vacuum pumps (Fig. 16) are in duplicate, and are electric driven, by silent chains. They run continuously, that is, there is no attempt to control them by stopping and starting mechanism. They discharge the warm water through the first tempering heater on the fan side of the washer, which acts as an economizer, and from this the cooled water passes to the sewer. The economizer is placed here as giving a reasonably low inlet air temperature, and being in no danger of freezing.

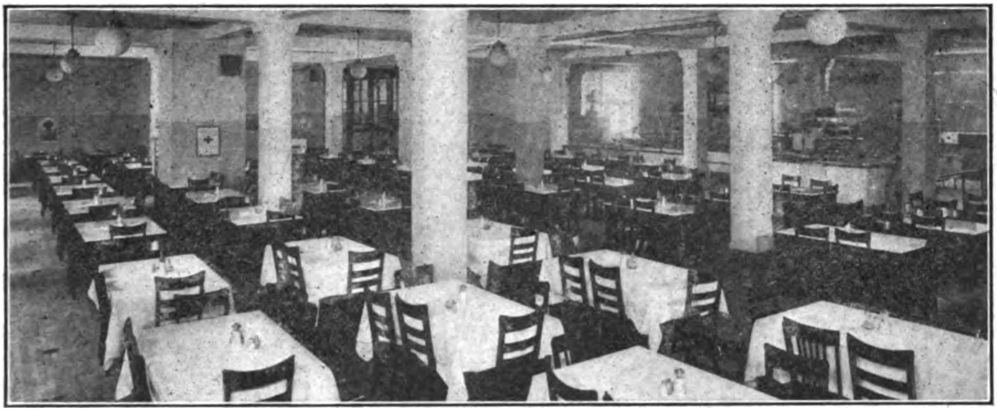


FIG. 15.—CAFETERIA, FIRST FLOOR, SWIFT & CO. BUILDING.

Particular attention was paid to the provision that no odors from this room should rise up through the offices above. The measures adopted to prevent this proved successful. About 400 people at one time can be accommodated in this room, and several thousand are fed here every day.

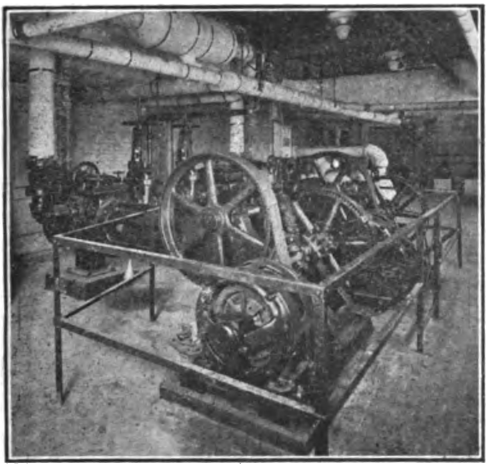


FIG. 16.—VACUUM PUMPS FOR HEATING SYSTEM, SWIFT & CO. BUILDING.

When the heating system is in operation one of these duplicate pumps is always exhausting the condensed water and the air from the radiating surface.

All closet fixtures throughout have register faces behind them, through which strong currents of air pass en route to the exhaust fan, removing odors. In the old installation a very objectionable smell of clothing was noticeable throughout the corridors and lobby. In the new, the check-rooms are kept at less air pressure than the rooms with which they communicate, having exhaust fan connections, so that these odors cannot be observed.

It was impracticable to install duplicate air-handling machinery, due to cost and complication of ducts, and since so little trouble ever originates with fans, there was danger that the idle units would deteriorate from corrosion as soon as the active ones. Therefore, no duplicate fans and motors are provided. However, all motors are belted, so that they could easily be replaced in a few minutes, and duplicate fan bearings are kept in stock. In any event, the shutting-down for a few hours of any exhaust fan would not be disastrous, and the building is so arranged with its flue base reheaters as to be heated by gravity with the supply fan shut down, when necessary.

In order to neutralize as far as possible the corrosive effect mentioned, the air washer is being operated with caustic soda in the circulating water, at the rate of 1 lb. per 1,000 gal. of water, this being added each time the water is changed. Some further observation and experimentation is indicated in this connection. With an outdoor temperature of 102° the inside temperature was easily maintained at 79° at the warmest place in the building.

NEW HEAT TRANMISSION TABLES

A Remarkable Compilation of Factors as Given by Leading Authorities Covering Latest Types of Construction.

By WILLIAM R. JONES,

Superintendent, Department of Buildings and Grounds, University of Pennsylvania.

III

EXPOSURE CONSTANTS

		A Used by U. of Pa.	B German Gov. Buff. Forge	D Kinealy	G Austrian Gov. (Macon)	I Thompson	K Greene	L Hubbard	N Allen	O Hoffman	O Hoffman Ger. Gov.	Recknagle	Reitschel	Klinger	P Harding	T Amer. Rad. Co.	X Donnelly	Y Hauss	
1	North	.40	.10		.20	.25	.15	.32	.10	.10-.20	.15-.25	.25	.10		.15 .30	.10	.10	.10	
2	East	.10-.20			.15	.10	.10	.12		.05-.10	.10-.15		.10		.10 .20			.10	
3	South	—	—	—	—	—	—	—	—	—	—	-	-	-	-	-	-	—	—
4	West	.20-.30			.15	.15	.10	.20		.05-.10	.10-.15				.10 .20			.10	
5	Northeast	.20-.30						.22		.10-.20	.15-.25	.25	.10		.15 .30			.10	
6	Northwest	.40						.26		.10-.20	.15-.25	.25	.10		.15 .30			.10	
7	Southeast	—						.06											
8	Southwest	—						.10											
9	North, East. South & West	—						.16											
10	Heated Intermittently	.50	.50				.50		.40-.50	.20-.40	.50					.30			
11	Daytime only. Unexposed	.10	.10	.10			.10		.10		.10					.10			
12	Daytime Only Exposed	.30	.30	.30			.30				.30	.20				.20			
13	Exposed to Heavy Winds	—*					.15		.30		.10-.20	.10 .30	.10			.10		.05	
14	12' to 14½' High	See Formula		.03							.03								
15	Above 12' High											.10						.033	
16	14½' to 18' High			.065							.06							.066	
17	Above 18' High			.10							.10							.10	
18	Corner Walls	—		.05			.10							.20					
19	Air Leakage	—			.10														

*COVERED IN SELECTING OTHER EXPOSURE CONSTANTS

14-D——13 TO 14½' HIGH.

10-I——AT LONG INTERVALS.

11-I & 11-Ob—DAYTIME ONLY-CLOSED AT NIGHT.

12-I & 12-Ob—DAYTIME ONLY-OPEN AT NIGHT.

11-N——DAYTIME ONLY- ALLOWED TO COOL AT NIGHT.

13-N——NORTHERN EXPOSURE.

1-5-6-Ob—ROOMS HEAVILY EXPOSED.

16Y——ABOVE 15' HIGH.

$$t' = t + 0.03\,(h-10)t$$

$$t_1 = \frac{t'+t}{2} = t + 0.015(h-10)t$$

t' is temperature of air at ceiling.

t_1 is mean temperature.

t is temperature at floor

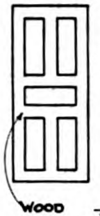
h is ceiling height

t_1 should not be greater than 1.15t

AMOUNTS TABULATED ABOVE ARE PERCENTAGES TO BE ADDED TO HEAT LOSS FOR NORMAL SOUTHERN EXPOSURE.

HIGHER AND LOWER FIGURES FOR MAXIMUM & MINIMUM EXPOSURES.

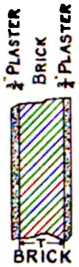
DOORS



THICKNESS	USED AT U. OF PA. A	B GERMAN GOV. (WOLFF)	RECKNAGEL & REITSCHEL C				D.F. STURTEVANT CATS. 84 6215 (A.R. WOLFF) F	AUSTRIAN GOV. (MACON) G				GREENE 1913 I	BUFFALO FORGE CO. J	HARRISON M	ALLEN N	TWEED Q	NAT. DIST HEAT. ASSO. R	PRACTICAL ENG. S	AMERICAN RAD. CO. T	HAUSS GER. PRACTICE Y	H. & V. MAGAZINE W	O HOFFMAN	L HUBBARD	PRUSSIAN GOV. (RECKNAGEL) V	Z IRWIN
			PINE		OAK			SOFT WOOD		HARD WOOD															
			INNER	OUTER	INNER	OUTER		INNER	OUTER	INNER	OUTER														
½"			.52	.56	.64	.70																			
¾"			.44	.47	.59	.63		.46	.49	.60	.69	.55													
1"			.39	.41	.54	.58		.39	.42	.54	.63	.48	.41			.48					1.00	.40	.40		
1¼"			.34	.36	.50	.54															GIVEN AS DOOR OR SINGLE GLASS				
1½"			.31	.32	.47	.50		.31	.33	.47	.53	.40	.32			.43									
2"			.26	.27	.41	.43		.26	.28	.42	.46	.34	.27			.31						.36	.30		
2½"			.22	.23	.37	.39		.21	.23	.37	.41														
3"			.19	.20	.33	.35							GIVEN AS PINE DOOR												
STANDARD THICKNESS		.414																.40	.42	.40				.410	.414
																									.572 GIVEN AS WOOD AND GLASS DOOR
STANDARD THICKNESS																									
TYPE																			GIVEN MERELY AS DOOR	THICKNESS NOT GIVEN					
OUTSIDE DOORS	.56											.55			.42	.48									
INSIDE DOORS	.40											.34				.31									
65% WOOD 35% GLASS	.57						.572										STORM								
DOUBLE DOORS	.27																.27								
SINGLE DOOR, 1¾" THICK	.44																.44								
DITTO, WEATHER STRIPPED	.34																.34								
PLAIN DOOR	.42						.414							.41											

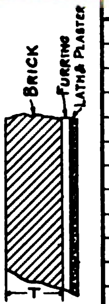
● — FOR OUTSIDE DOORS.
⊗ — FOR INSIDE DOORS.

WALLS



BRICK PLASTERED BOTH SIDES

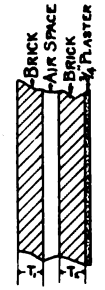
Thickness T	Used by U of P A	German Gov. (Wolff) B	Recknagel & Reitschel C	Kinealy D	Hubbard L	Austrian Gov (Macon) G	Greene (1913) I	Buffalo Forge Co. J	Hoffman O	Harding P	Tweed Q	Nat. Dist. Heat Asso. R	Thompson One Wall Exp. He	Thompson Two Walls Exp. He	H & V Magazine 1917– W	Donnelly X	Busey U
4"	.43		.43												.43		
8"	35		.33			.40									.33		
12"	.28		26			.31									.26		
16"	.24					26											
20"	.21					22											
24"	.18					.19											
28"	.17					17											
32"	.15					.15											
36"	13					.14											
40"	.13					.13											



BRICK FURRING, LATH AND PLASTER ONE SIDE

Thickness T	AA	BB	CC	DD	LL	GG	II	JJ	OO	PP	QQ	RR	HH	HH	WW	XX	UU
4"	.33		.29	.28			.28	^{4}.28			.28	.29			.56		
8"	.27		.24	.23	.32		.24	$^{8\frac{1}{2}}$.23	.280	^{9}.217	.24	.27			.30	$^{8\frac{1}{2}}$.414	$^{8\frac{1}{2}}$.23
12"	.23		.21	20	.26		.20	^{13}.20	.217	^{13}.165	.20	.24	.265	.232	.23	^{13}.300	^{13}.20
16"	.21		.20	18	.21		.18	$^{17\frac{1}{2}}$.18	182	^{18}.156	.18	.21			.20		$^{17\frac{1}{2}}$.18
18"	.20		In place of furring German prac. uses plaster board 1.18" thick with air space. It is made of mortar and plaster of Paris										.210	.205		$^{17\frac{1}{2}}$.228	
20"	.19			.16	.18		.16	^{22}.16	.161		16	.18			.18		
21"	.18												.187	.185		^{22}.200	^{22}.16
24"	.16				.16		.14		.147	$^{22\frac{1}{2}}$.132	.14		.167	.150	.16		
27"	.15												.152	.140		$^{26\frac{1}{2}}$.157	
28"	.15				.14		.13		.133		.13				.14	Based on tests by Harding	
30"	.14				Given as 80% of plain brick					?			.140	.130			
32"	.13						.12		.119		.12				.12		
33"	.13								.7 of Non-Furred Wall				.130	.120			
36"	.12												.120	.113			
40"	.11												.112	103			

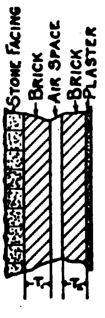
WALLS



BRICK WITH AIR SPACE ¾" PLASTER

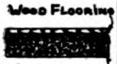
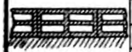
T = T₁ + T₂

Thickness T=T₁+T₂	Used by U of Pa. A	Recknagel & Reitschel C	Peclet (Carpenter) E	Austrian Government (Macon)	G	Greene 1913 I	Buffalo Forge Co. J	Hubbard L	Thompson: 1 Wall Exposed, Furred and Plastered He	Thompson: 2 Walls Exposed, Furred and Plastered He	Thompson: 1 Wall Exposed 15% Added, Plastered On	Thompson: 2 Walls Exposed 15% Added, Plastered On He	Thompson: 1 Wall Exposed 20% Added, Without Furring or Plaster He	Thompson: 2 Walls Exposed 20% Added, Without Furring or Plaster He	Nat. Dist. Heat. Ass'n R	Busey U
4"	.36		.36													
8"	.27	.25	.30	.23		.27	$^{8\frac{1}{2}}$.25	.340							.25	^{8}.25
12"	.22	21	.25	.19	.27	.22	^{13}.21	.272	.220	.170	.253	.196	.264	.204	22	^{13}.21
16"	.19	.19	.21	.17	.22	.19	$^{17\frac{1}{2}}$.19	.221							.19	$^{17\frac{1}{2}}$.19
18"	.17		.19						.175	.137	.201	.158	.201	.164		
20"	.16	.16	.18		.19	.17	^{22}.16	.187	.160	.125	.184	.144	.192	.150	.16	^{22}.16
24"	.15	.14	.17		.17	.15	$^{26\frac{1}{2}}$.14	.170	.147	.115	.169	.132	.176	.138		
28"	.13	.13	.15		.15	.13		.153	.135	.105	.155	.121	.162	.126		
32"	.12	.12	.13		.13	.12		No Plaster 85% of Plain Brick	.117	.090	.135	.104	.140	.108		
36"	.12	Air Space 2.4"	12	Air Space 1"	.12				.110	.084	.127	.097	.132	.101		
40"	.11		.10		.11				.100	.077	.115	.089	.120	.092		
30"	.13				Air Space 2"				.125	.097	.144	.112	.150	.116		

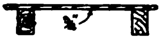
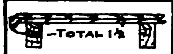
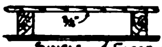
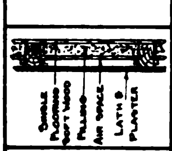
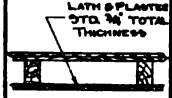


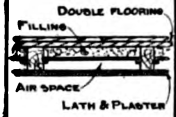
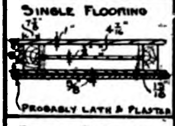
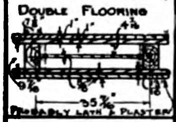
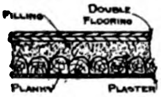
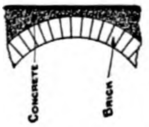
T = T₁ + T₂

Thickness T=T₁+T₂	Used by U of Pa. A	Recknagel & Reitschel C	Peclet (Carpenter) E	Austrian Government (Macon)	G	Greene 1913 I	Buffalo Forge Co. J	Hubbard L	Thompson: 1 Wall Exposed, Furred and Plastered He	Thompson: 2 Walls Exposed, Furred and Plastered He	Thompson: 1 Wall Exposed 15% Added, Plastered On	Thompson: 2 Walls Exposed 15% Added, Plastered On He	Thompson: 1 Wall Exposed 20% Added, Without Furring or Plaster He	Thompson: 2 Walls Exposed 20% Added, Without Furring or Plaster He	Nat. Dist. Heat. Ass'n R	Busey U
	A															
8"	.25		Given for brick or stone with air space. Does not state whether plastered or not	Does not state whether	Plastered or not. Probably plastered.	.32									Given as brick, hollow and plastered	
12"	.20					.20										
16"	.17					.17										
20"	.15					.15										
24"	.14					.14										
28"	.12					.12										
32"	.12					.12										

FLOORS	THICKNESS	USED AT U. OF PA. A	THOMPSON Hab	GREENE 1913 I	BUFFALO FORGE CO. J	HARDING P	HAUSS GER. PRACTICE Y	TWEED Q	NAT. DIST. HEAT ASSO. R	AMERICAN RADIATOR CO. T	H&V. MAGAZINE 1917 — W	IRWIN Z
DIRT FLOOR SURFACE		.20	.23 GROUND TEMPERATURE ASSUMED TO BE 50° F.		.20			.20	.13	.23	.23	
CEMENT OR CONCRETE EARTH		AA	HHa		JJ	PP	YY	QQ	RR	TT		ZZ
		.31	.31		.31	2" .784	.08	.30	.29	.31		.29
			HHb			3" .714	STONES LAID ON EARTH					STONES LAID ON EARTH
			.30			4" .655						
						".563						
WOOD FLOORING  CEMENT OR CONCRETE		AAA	HHHa		JJJ			QQQ	RRR		WWW	
		.12	.08		.10			.10	.14		.10	
PLANK ASPHALT		AAAA				NNNN	YYYY		RRRR			ZZZZ
		.20					.20		.20			.20
TILE 		AAAAA	HHHHHa	IIIII	JJJJJ			QQQQQ	RRRRR			
		.31	.31 GROUND TEMPERATURE ASSUMED TO BE 50° F.		.31			.30	.29			
TILE ON GROUND NO WOOD FLOOR ABOVE	PP— 1" FINISH ON TOP NOT SPECIFIED WHETHER FLOOR OR CEILING. EARTH UNDER CONCRETE NOT SHOWN											

FLOORS	THICKNESS	USED BY U. OF PA. A	GERMAN GOV. (WOLFF) B	RECKNAGEL & REITSCHEL C	B.F. STURTEVANT CATS. 84&215 (A.R. WOLFF) F	THOMPSON Hab	GREENE 1913 I	BUFFALO FORGE CO. J	ALLEN N	HOFFMAN O	TWEED Q	NAT. DIST. HEAT. ASSO. R	H.&V. MAGAZINE W	DONNELLY X	HAUSS GER. PRACTICE Y	IRWIN Z
WOOD FLOORING TILE ON GROUND		.11				.08		.10 TEMPERATURE OF EARTH GIVEN AS 50° F			.10	.14				
CEMENT TILE ON GROUND		AA											WW			
		.30											.30			
SINGLE FLOOR WITH SLEEPER ON EARTH		AAA				HHHa		JJJ				RRR	WWW		YYY	ZZZ
		.13				.10		.10				.13 PLANKS LAID ON EARTH PROBABLY NO SLEEPERS	.10		.16 PLANKS LAID ON EARTH	.16 PLANKS LAID ON EARTH PROBABLY NO SLEEPERS.
						HHHb										
						.10										
WOODEN BEAMS PLANKED OVER AS FLOORING		AAAA	BBBB		FFFF				NNNN	OOOO		RRRR		XXXX		
		.13	.083 GIVEN AS WOODEN BEAM CONSTRUCTION PLANKED OVER AS FLOORING SEE FOLLOWING SHEET #32		.083 PROBABLY MEANT FOR USUAL FLOOR OF JOISTS & BOARDS				.083 SEE SHEET NO. 32	.17 DIMENSIONS NOT GIVEN. STANDARD 3"x12" BEAM AND 3" PLANK ASSUMED		.13 MILL CONSTRUCTION		.214 MILL CONSTRUCTION		
STANDARD WOOD FLOORING ON 3" PLANK 12"x12" WOOD GIRDERS		AAAAA					IIIII									
		.16					.16									

FLOORS	THICKNESS	USED AT U. OF PA. A	GERMAN GOV. (WOLFF) B	KINEALY D	B.F. STURTEVANT F	IRWIN Z	AUSTRIAN GOV. (MACON) G	THOMPSON Ha	GREENE 1913 I	BUFFALO FORGE CO. J	SNOW K	HUBBARD L	HARDING P	HOFFMAN O	TWEED Q	NAT. DIST. HEAT. ASSO. R	PRACTICAL ENG. U	AMER. RAD. CO. T	DONNELLY X	HAUSS Y	H&V. MAGAZINE 1917 W
 SINGLE FLOOR. NO PLASTER BENEATH FLOOR		.29	.083 GIVEN AS WOODEN BEAM CONSTRUCTION PLANKING OVER AS FLOOR (PARQUETRY CONSTRUCTION [illegible])	.45	.083		.33	.10	.33	.45	.186			.45	.40	.36		.083	.30		.45
 DOUBLE FLOORING NO PLASTER BENEATH JOIST		AA		DD		ZZ		HHa	II	JJ	KK				QQ	RR				YY	WW
		.20		.31		.07		.08	.23	.31	.129				.27	.26				.07	.31
		AAA		DDD				HHHa	III	JJJ	KKK			OOO	QQQ	RRR			XXX		WWW
		19		.26				.08	.031	.26	.114			.26	.20	.25			.20		.26
 DOUBLE FLOORING SOFT WOOD FILLING AIR SPACE LATH & PLASTER		AAAA					GGGG									RRRR					WWWW
		.05					.05 COLD AIR UNDER					GIVEN AS DOUBLE WOOD FLOOR	GIVEN AS WOODEN [illegible] FLOOR			.05					
 DOUBLE FLOORING LATH & PLASTER BENEATH JOIST		AAAAA		DDDDD				HHHHHa	IIIII	JJJJJ	KKKKK	LL LLL	PP PPP	OOOOO	QQQQQ	RRRRR	UU UUU				WW WWW
		.13		.18				.06	.030	.18	.071	.10	.20	.10	.10	.21	.10				.18

FLOORS	THICKNESS	USED AT U OF PA. A	RECKNAGEL & REITSCHEL C	AUSTRIAN GOV. (MACON) G	BUFFALO FORGE CO. J	HUBBARD L	HOFFMAN O	TWEED Q	NAT. DIST. HEAT. ASSO. R	H. & V. MAGAZINE W	HAUSS GER. PRACTICE Y						
		.05		.045 GIVEN AS FLOOR WITH COLD AIR UNDER					.05								
 SINGLE FLOORING 7⅞" 1" 4 3/16" ⅝" 13/16" PROBABLY LATH & PLASTER		AA	CC		JJ												
		.07	.07		.07												
 DOUBLE FLOORING 7⅞" 1" 1" 4 3/16" 9 5/16 ⅝" 13/16 35 7/16" PROBABLY LATH & PLASTER		AAA	CCC		JJJ												
		.06	.06		.06												
		AAAA		GGGG													
		.06		.055													
CONCRETE FLOOR ON BRICK ARCH 		AAAAA				LLLLL	OOOOO	QQQQQ		WWWWW	YYYYY						
		.20				.20	.20	.20		.20	.20 GIVEN AS STONE FLOOR ON ARCHES						

CHICAGO COMMISSION ON VENTILATION

TEST OF CHICAGO AND COOK COUNTY SCHOOL FOR BOYS

EDITED BY MEYER J. STURM

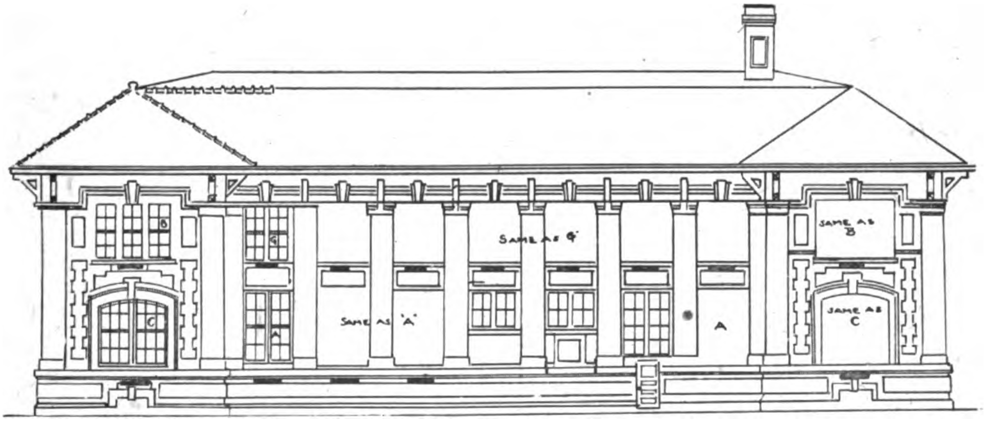
The Chicago and Cook County School for Boys is one of a group recently designed and is comparable in general arrangement to an ordinary elementary school. The entire group of buildings will be supplied with steam from a central boiler plant which is now being built. At present, as described herein, this building has its own temporary plant.

The accompanying plans show the general arrangement of the rooms.

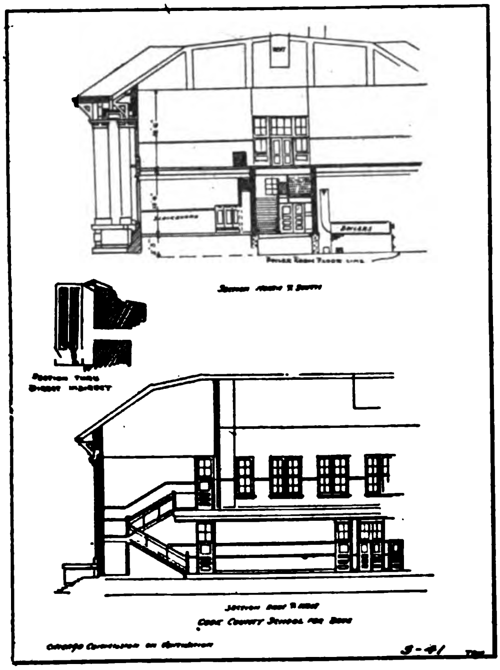
Probably as a measure of economy, no other reason being apparent, a rather unique system of heating and ventilating was installed. The steam circulation is obtained by a double-pipe overhead downfeed system, the returns passing to a receiving tank in the basement and being delivered from the tank to the boiler by an electric pump. There is no direct radiation, independent of the so-called ventilating system. Radiation is of the cast-iron wall type, each radiator being two units wide, encased in sheet steel, and arranged with dampers below and register faces above, so that air may circulate around the radiators. This air is supplied to the radiators as may be desired by damper adjustment, either from out of doors, or from the rooms themselves. In this manner, to some extent, by adjusting the dampers, and by turning off or on the steam in the radiators, temperature regulation is possible. This, however, can only be obtained manually.

The intake openings from outside to the radiator casings, are each 3½-in. wide x 46 in. long, and in each of the standard classrooms there are three such inlets.

The exhaust openings for the first floor are near the ceilings inside the wardrobes, which have slide-up doors arranged so that when they are closed



ELEVATION, CHICAGO AND COOK COUNTY SCHOOL FOR BOYS.

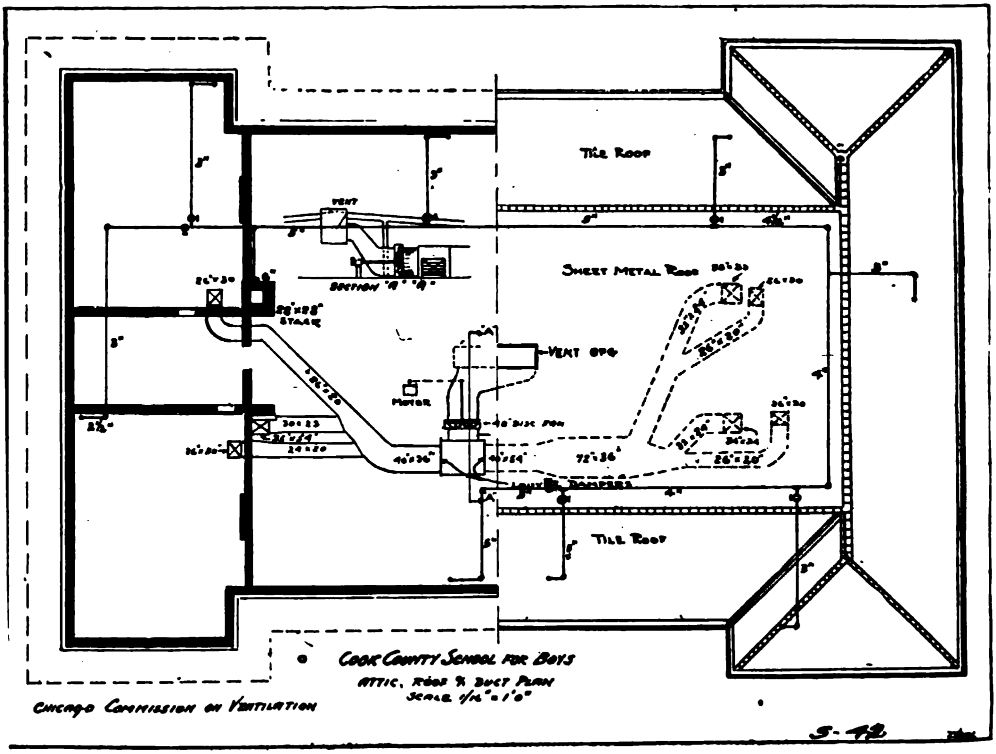

Cook County School for Boys
Chicago Commission on Ventilation
S-41

SECTIONAL VIEWS, CHICAGO AND COOK COUNTY SCHOOL FOR BOYS.

there is a space 6-in. from the floor to their lower edge through which air leaves the rooms. The second floor rooms do not have wardrobes, so that the exhaust registers are 8 ft. above the floor connected directly into the flues. The vertical flues, except in the third floor, are so arranged that each flue exhausts from super-imposed rooms on both the first and second floors. The second floor openings into the flues have steel elbows or shields projecting out into the flues behind the registers. All vent flues are connected in the attic, to a gathering chamber.

Where the two main trunk line ducts, one from each half of the building, join the gathering chamber, there are placed balanced louver shutters which open to permit passage of air from the ducts to the chamber and close to prevent any air movement away from the chamber and into the exhaust ducts.

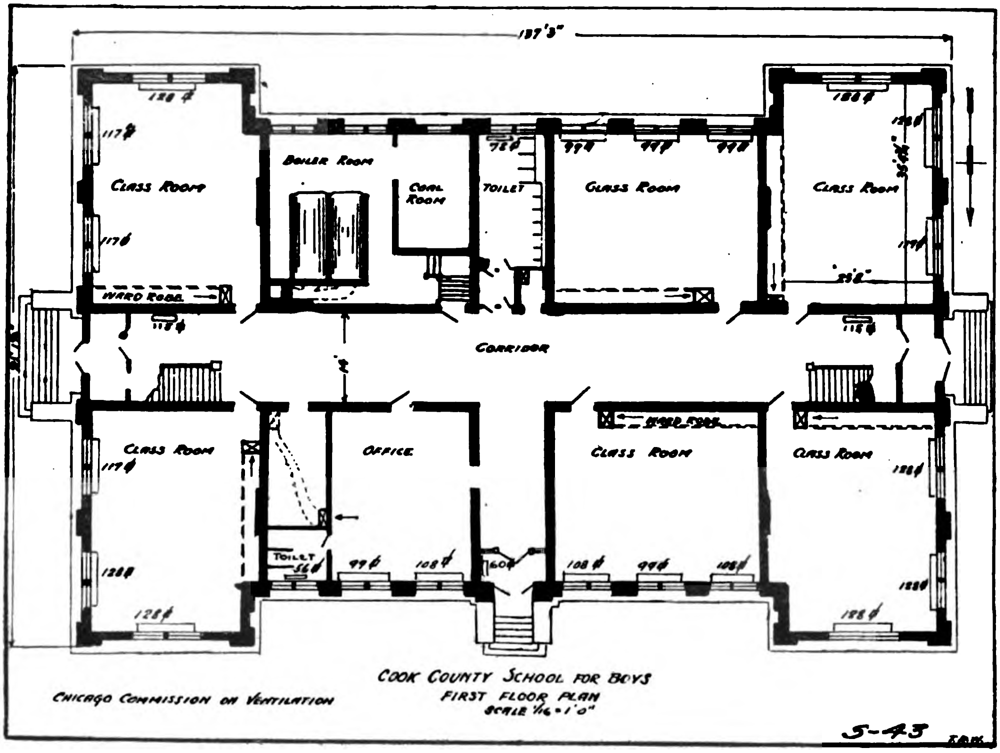
The exhaust fan is a 48-in. disc fan which operates at constant speed and



ATTIC, ROOF AND DUCT PLAN, CHICAGO AND COOK COUNTY SCHOOL FOR BOYS.

no appliances are provided for varying the amount of air handled by this fan. The discharge is through a large opening at about the level of the roof.

The plant comprises an elaboration of the type of ventilation and heating known as direct-indirect and is better than the usual attempts at this because of the comparatively large fresh air intakes, the positive exhaust, and the means provided for varying the air volume and temperature. Compared with the usual installation of direct-indirect heating and ventilation for schools, this plant is very much more liberal as to areas and capacities and is further equipped with a mechanical exhauster.



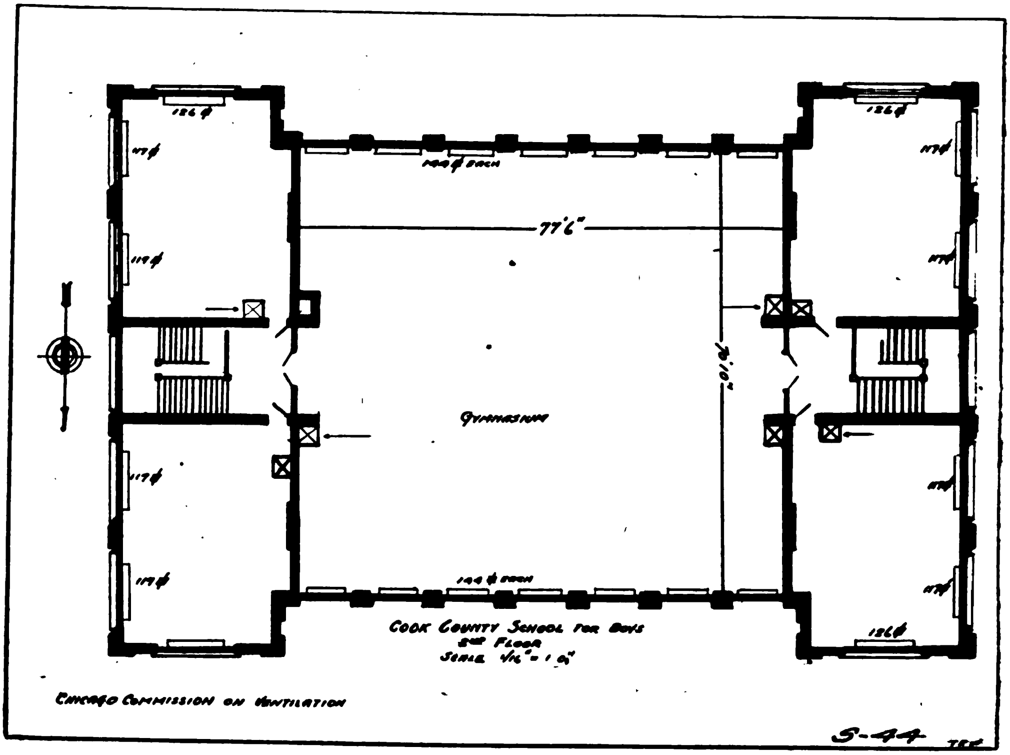
FIRST FLOOR PLAN, CHICAGO AND COOK COUNTY SCHOOL FOR BOYS.

DIRECT-INDIRECT HEATING.

For the purpose of establishing a working definition for the system installed in this school, the following descriptions are given:

Direct heating is the term used when the heating surface, such as steam, water or electric radiators or stoves, is placed in the rooms, recirculating the air in the rooms, no attempt being made to introduce fresh air. Indirect heating is the term used when the heating surface is placed outside the room or in such manner that constant supply of heated air is conveyed into the rooms.

Direct-indirect heating is the term used to describe a system by which direct radiators, or part of them, placed in the room, are partially or wholly encased, and arranged with air supply inlets directly from outside, through the walls, usually under the windows. To introduce any fresh air it is necessary to remove from the room the air which the fresh air is to replace. Ordinarily vent flues are provided, usually with the intention of drawing the air from the floors of the rooms, where it



SECOND FLOOR PLAN, CHICAGO AND COOK COUNTY SCHOOL FOR BOYS.

is presumably coolest. These flues have no efficiency in removing air unless they are warmer than the air outside, and will, unless affected by some local wind condition, have a reverse current whenever they are cooler than the air outside. It is necessary, therefore, in order to secure results with a direct-indirect system of heating and ventilation, to heat the vent flues, or to provide mechanical means to exhaust the air.

Such an attempt at heating and ventilating will not amount to much in the handling of the air, when the fan (if mechanical exhaust is installed) is not in operation, unless the outside temperature is 40° F. or more cooler than the air in the building.

Since the fresh air inlets for this building are in vertical walls, they are necessarily exposed to extreme wind effects and those to windward will deliver excess air, while those to leeward often become outlets, due to the lowered pressure, and to eddy currents.

Since the volume and temperature of the entering air are subject to such great fluctuations, it is evident that the means of regulating the volume and of varying the amount of heating surface with which the air comes in contact should be considerably refined.

With a full knowledge of these conditions, the Chicago and Cook County School for Boys was selected by the Chicago Commission on Ventilation for observation and test, in order that some comparison might be drawn with other school building plants tested or to be tested by the Commission.

Preliminary observations and tests, however, demonstrated at once that owing to conditions of occupancy and because of the profound influence of wind and weather, no particular comparison except as concerned the general system could fairly be drawn.

In the January issue the results will be presented of three ventilation tests in one of the classrooms in this building: with the exhaust fan not running, with the exhaust fan running, and, third, with the fan running and a high wind from the northwest.

UNITED STATES FUEL ADMINISTRATION

Articles appearing in this department are published with the endorsement of the United States Fuel Administration at whose request THE HEATING AND VENTILATING MAGAZINE *is co-operating in a national plan for fuel conservation. It is the fuel administration's desire that we publish in each issue a strong, authoritative article on fuel conservation, regarding the phases of economy which may apply to the heating and ventilating industry. The Fuel Administration is issuing invitations to authors throughout the country to keep editors supplied with desirable conservation articles. Our readers can assist in this work very materially by sending in data and other matter that would be suitable for this department.*

FUEL ECONOMY RESULTS OBTAINED IN HOUSE HEATERS

By A. BEMENT.

One of the reasons why the usual operator of a heating boiler does not readily grasp the essentials of the combustion problem is that he has no visual evidence of the air supply, or, the fact, that while burning one ton of coal, he uses very many tons of air in the process. If this were apparent, air supply would command more attention. The result is that a belief prevails that because a good draft is desirable, it is not possible to have too much of a good thing. This leads to the use of very much more air than necessary, with the result that large quantities of heat are carried to the chimney in this air, which flows through the furnace without assisting in the production of heat or in any way contributing to the combustion process. After long experience I find that in general practice the matter may be reduced to the two simple elements of proper placing of the coal and control of draft.

THE TIME TO FIRE.

The time to fire is when the fuel bed has burned down to such a stage that it requires replenishing to maintain its standard condition, not when steam is low, or when heat is required. The more common practice in heating service is to fire when steam pressure gets low, or heat is desired, and when little heat is needed to run a very thin fire, in some cases the fire door being open, this is wasteful. The time to fire is not when heat is needed, in fact it has nothing to do with the proper firing period. Economy demands that a certain character of fuel bed be maintained all the time, and this implies a good strong fire. It does not follow, however, that this fire need burn rapidly. The rate of steam and heat production should be controlled by the draft; in this way there will always be a good fire ready to respond to any demands made upon it. Thus, it is apparent that the character and thickness of the fuel bed is the feature that produces the economy, and the draft, the one that produces capacity. Two or three cases from actual practice will serve to illustrate these points.

SPRINKLING POCAHONTAS OVER ANTHRACITE.

A residence steam boiler, using anthracite coal, was fired by a janitor. The owner, having absorbed some ideas on better combustion, wanted the janitor to change his method, which the janitor declined to do. The owner then fired the boiler himself for the remainder of the winter. His procedure was as follows:

In the morning, after shaking down the grate, he put about as much coal in the furnace as it would hold, and having a small quantity of fine Pocahontas on hand, he sprinkled some of it over the top of the anthracite as a finishing touch. The result was that the thickness of fuel was sufficient to utilize all of the air which could get through it; this produced a very high efficiency. The steam pressure was constantly at the point at which the regulator was set, and it was carried with a very small damper opening. In the evening the fire, of course, was burned down but still there was a heavy bed which he again renewed the same as he had done in the morning. The result of his improved practice was that coal consumption dropped to one half of what it had been previously and he always had heat.

IMPORTANCE OF FILLING HOLES IN THE FIRE.

In an apartment house where Pocahontas coal was used, the owner complained of the excessive fuel cost. He sought advice and was given a line of instruction which he was told to pass on to the janitor. As this was without successful result, it appeared necessary to give him practical illustration as follows: At nine o'clock in the morning after the janitor had fired the boiler three times, steam pressure was 1½ lbs. with the damper wide open, and the coal was found to be caked together in masses with large openings between and under, through which air flowed to the chimney practically without contributing to the combustion process. The owner took a poker and broke up the fire and leveled it evenly, then added a certain small quantity of coal at thin spots and holes. To do this he used a small shovel belonging to the hot water heater. His attention was called to a hole in the fire which could be plugged with a small lump, then to a vacant place in a corner. When the surface of the fuel bed had been repaired in this manner, which required only a few minutes, about two ordinary shovels of coal had been used in the process. He was then told that when a furnace was coaled, it should be done with about the same care as required in laying a brick pavement. Attention is directed to the fact that in preparing this fire only two shovels of new coal were used. In a few minutes pressure rose to 3 lbs. at which the regulator was set and the furnace went under the control of the damper and remained under its control until 3:00 in the afternoon without any further attention.

WASTE OF COAL DUE TO FORCING BOILER.

In the case of a hot-water heated house, the radiation was not sufficient. The result was that the owner ran the boiler with the damper wide open in an effort to get the house warm which he could not do for the lack of radiating surface. But because the house did not get warm he still kept the strong draft on the boiler. Of course he could have heated the boiler better by using a reasonable amount of draft, but the fact that he could not make the place comfortable led him to believe that a full damper opening would help him out of his troubles. After a while he became disgusted and added a stove as an auxiliary to his heating plant; then his house became warm. It was no longer necessary to expect so much of the boiler, so he cut down the draft with the result that a large saving was made with the fuel used in the hot-water heater, and the total coal comsumption dropped considerably over what it had been before the stove was installed. The-owner was disposed to attribute the improvement to reduced work done by the hot-water heater, when as a matter of fact, it did as much work as before only under very much more economical conditions. The feeling that less work would be expected of the hot-water heater led to cutting down the draft and producing the economic condition, but the economy in fuel was brought about by the draft control, and a comfortable temperature in the house was produced by the auxiliary heating by the stove.

Data Wanted by United States Fuel Administration.

At the request of the United States Fuel Administration, THE HEATING AND VENTILATING MAGAZINE invites its readers to write us concerning the savings that have been made by following he fuel administration's recommendations. Plants which have carefully followed these suggestions should now be able to report interesting facts about what has been accomplished. The replies received will be published in these columns, as far as space conditions will permit.

The data should cover three points:

1. What was done?
2. How was it done?
3. What results were obtained?

The fuel administration believes that in this way many nteresting facts will be brought to light and that those responding will be rendering a valuable service to the fuel conservation programme.

Fuel Saving by Industrial Plants.

Through the co-operation of the industrial power plants, which have thus far put into force the standard recommedations of the United States Fuel Administration to promote efficiency in the use of fuel in power plants, a savng of 7,000,000 tons annually has been effected. That is to say, in the first six months from the announcement of the National program, 3,500,000 tons have been conserved, at the same time maintaining maximum production in the factories.

Some industrial plants which have adopted the standard recommendations and kept systematic records report of a fuel saving as high as 25 per cent, and the average is estimated between 10 per cent and 15 per cent.

A fuel administration campaign comprehends voluntary service by engineer inspectors, lecturers to fuel conservation classes in educational institutions, addresses before public meetings, explanations of the program to power plant owners, and various forms of printed matter and posters.

For the efficient execution of the program of industrial conservation, under the plan developed, the engineers of the country were mobilized through the professional societies and the operating engineers and firemen, and as a result there are today fifteen hundred volunteer engineer specialists and power plant men organized by States, inspecting power plants, classifying them according to their operating efficiency, and aiding the work of rapid. development. As a direct result of the operation of this plan, it is estimated that the total annual saving throughout the country will be about 25,000,000 tons of coal without reducing the output of the factories. Special printed material, instructing on the proper use of fuel

Bituminous Storage Limit Off.

All storage restrictions on bituminous coal have been removed by the United States Fuel Administration in conformity to the action of the War Industries Board in cancelling its preferential industries list. Anthracite coal is not affected, however, by the ruling of the fuel administration.

Coal Savings by Zoning System.

Estimates made earlier in the fuel year that approximately 160,000,0000 car miles would be saved in the coal year through the operation of the zone system for the distribution of bituminous coal, are being realized, it is announced by the United States Fuel Administration. This method of distribution was established so that the coal supply of all sections of the country should normally be derived from mines relatively near.

In view of the increased supply of bituminous coal now available, Fuel Administrator H. A. Garfield has issued an order, under date of November 14, modifying the fuel restrictions put upon the manufacture of different clay products and the restrictions on the consumption of fuel in the manufacture of cement. The new order reduces the percentage of curtailment one-half in every case.

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A. S. ARMAGNAC....................*President*
GUSTAVE PETERSEN....*Secretary and Treasurer*

A. S. ARMAGNAC, Editor
GUSTAVE PETERSEN, Business Manager
HAROLD L. ALT, Contributing Editor

European Representative:
W. G. HOLLINWORTH, 304 High Holborn
London, W. C.

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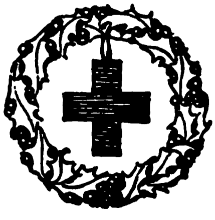


WITH the sudden transition from war to peace conditions the business world finds itself in the condition of a man waking up from a horrible nightmare and rubbing his eyes to make sure he is really awake. The war fever had become so intense that the sheer momentum of our efforts carried us along for a time in spite of the first exuberance of joy over the great victory. When the reaction did come there was an inevitable let-down and a feeling in many minds that war efforts were no longer necessary.

It is true that a vast amount of work and preparation, both in the manufacture of war materials and in the supply of personal comforts for the army, will not now be required, but the danger is that the still pressing needs in the latter direction will be minimized and, possibly, overlooked.

At the urgent request of the American Red Cross we are devoting this space to the Christmas Roll Call of the Red Cross, which is scheduled for the week begining December 16. It is hoped that as a result of "Roll Call Week," national membership in the Red Cross will be limited only by the limits of population; the present membership is 20,000,000 as compared with 300,000 in 1916. Besides the military work of the Red Cross, which is carried on not only for the army of the United States, but for the sick and wounded of the allied armies, a tremendous service has been given, and as much more remains to be given, to the victims of the war in the devastated regions of France, Belgium and other countries.

Between 2,000 and 3,000 workers are now in France where no less than twenty-nine warehouses take care of an average shipment of 15,000 tons per month. It is safe to say that this organization will continue to serve during the coming year in helping to bind the wounds left by a destruction of territory and property which is beyond the mind to grasp.

FROM a commercial point of view interest centers in America's reconstruction programme which is being outlined. as these lines are written, at the great convention of war service committees in Atlantic City. It seems that America is as ill prepared for peace as it was for war and the big job before American business men today is to cut away, as rapidly as safety will permit, the restrictions and curtailments that have transformed industry as we knew it before the war. But in that process the industries are facing the vital question of whether we shall enter upon a competitive era surpassing anything known in the past or whether a larger vision will point the way toward wider co-operation in American business to meet a world-wide competition. May the slogan be, "Onward together!"

OPENING OF THE RECONSTRUCTION ERA

Germany's Collapse Brings the Country's Industries Together to Prepare for Peace Conditions.

The sudden termination of the world war found the industries of America on a vast war basis, the mighty power of which was just beginning to be felt. It is well known that America had not reached the zenith of her strength when Germany sounded her cry for peace, but that, on the contrary, her forces were being rapidly whipped into shape for a stupendous blow in the Spring of 1919.

Such was the situation on November 11 when the word was flashed that the armistice was signed and the war practically won. Even then the completeness of the victory and the dire straits to which Germany has been reduced were not at first realized. But with the publication of the armistice terms and the subsequent events that followed in rapid succession it was apparent to all that the miltary power of Germany had indeed been overcome without hope of resurrection.

With commendable promptness the Chamber of Commerce of the United States immediately set about the task of assembling the business interests of the country to deal with the tremendous problems of reconstruction. Under the chamber's auspices a convention was called at Atlantic City December 3-6, of the 350 war service committees representing all of the industries engaged in war work. This meeting, it was expected, would bring together from 2000 to 3000 industrial leaders. According to the programme the first day was to be given up to separate meetings of these committees for formulating the policies of the various industries represented.

It was then planned to gather the war service committees in 35 related groups. Afterwards these related groups were to assemble as ten major groups representing the ten primary industries within the United States which were defined as food products, textiles; heat, light and power; metals and minerals other than iron and steel; iron and steel; wood and wood products; chemicals; leather; earthern products, and industrial professions.

The speakers included Secretary of Commerce William C. Redfield, A. C. Bedford, James A. Farrell and Paul Warburg.

In the 35 related groups were included coal and coke; public utilities; machinery; tools and power equipment; building materials (except those otherwise specified); engineers, architects and accountants; and trade papers, magazine, newspapers and house organ editors.

A list of 25 questions was sent out by the war service executive committee to the members of all war service committees for use as a basis for the deliberations of the individual war service committees at their first meeting. These questions covered such topics as "What legal methods or means can be introduced in the craft to better stabilize prices during the reconstruction period, affected by inventories on hand, orders placed at war prices but not delivered, labor costs and conditions," etc. Other questions considered the labor situation, financing problems, cancellation of government war orders, the continuation of the War Industries Board, sources of raw materials, uniform methods of cost accounting, methods to simplify production, effect of foreign competition, disposition of the merchant marine, the general question of foreign trade, return of the army to industrial pursuits and, finally, the stimulation of public work and the construction of public buildings. In this connection the groups were invited to consider the building programme in the United States and especially the utilization or destruction of new plants built for war purposes, the location of convalscent and reconstruction hospitals near industrial centers so that the men in such hospitals can be trained in the factories nearest to the hospitals without creating new vocational schools.

The more important actions taken at the convention, as far as they relate to the field represented by THE HEATING AND VENTILATING MAGAZINE, will be presented in the January issue.

The idea that led to the calling of the convention was given by President Harry A. Wheeler, president of the Chamber of Commerce, in a letter to President Wilson, urging the immediate creation of a clearance committee to which all proposals to cancel contracts would be referred by the government departments concerned. The situation, it was set forth, should be controlled by some common authority and the letter pointed out the necessity of harmonizing the policies of the various departments engaged in war work. It was suggesed that a clearance committee, if named, should handle all cancellations, so that raw materials released by the cessation of war production might be allocated to industries able to use them immediately for peace time needs. Another serious situation emphasized by President Wheeler is that involving the protection of values in stocks of raw materials in hand "which a very large number of manufacturers engaged on government work purchased at the high prices which have prevailed and which they are now carrying. If, through sudden cancellation, these stocks are now freed and no arrangement is made for their utilization in some other direction, there is likely to be a very great decline in prices, temporary at least, until demands in other directions assert themselves."

◆

War Industries Board Announces Relaxation of Regulations.

Immediately upon the signing of the armistice by the Allies and Germany, the War Industries Board began to cancel restrictions upon industry which were imposed for the purpose of compelling conservation. In an announcement dated November 12, it was stated that it will be the policy of the board gradually to lift various restrictions and curtailments, with a view of bringing about as promptly as possible a return to normal conditions.

"In the modification of the curtailments imposed on the manufacture of certain commodities," continues the announcement, "the board has adopted the method of reversing the processes of the Priorities Committee, and there is announced today a list of commodities in respect to which the curtailment is modified.

"Hearty approval has been given by the Council of National Defense to modifications of the regulations governing non-war construction, and the council requested that immediate and widespread publicty be given him so that, to the extent now permitted, building operations might be speedily resumed."

The new order provides that construction projects falling within the following classifications are hereby approved, and no permits or licenses will be required therefor from the non-war construction section:

1. Construction projects approved in writing by the Facilities Division of the War Industries Board.
2. All farm and ranch buildings, structures or improvements.
3. All buildings, structures, roadways, plant facilities or other construction projects of every nature whatsoever, undertaken by the United States Railroad Administration, or by any rail or water transportation company, organization or utility (whether or not under the direction of such administration), or by the American Railway Express Company or by the owner or operator of any telegraph or telephone line.
4. The construction, maintenance, improvement or development by Federal, State or municipal authorities of highways, roads, boulevards, bridges, streets, parks and playgrounds.
5. The construction, extension, improvement, maintenance or repair of any public utility, including water supply systems, sewer systems, light and power facilities and street and interurban railways.
6. The construction, extension or repair of all irrigation and drainage projects.
7. Construction projects connected with the extension, expansion or development of mines of every character whatsoever or connected with the production and refining of mineral oils and of natural gas.
8. The construction, alteration or extension, repairs or additions to plants engaged principally in producing, milling, refining, preserving, refrigerating or storing foods and feeds.
9. The construction of new or the alteration or extension of existing schoolhouses, churches, hospitals, and Federal, State or municipal buildings involving in the aggregate a cost not exceeding $25,000.
10. The construction of new buildings or structures not embraced in any of the foregoing classifications, or the repairs or additions to, or alterations or extensions of, existing buildings or structures, in either case involving in the aggregate a cost not exceeding $10,000.
11. The construction of new buildings or structures not embraced in any of the foregoing classifications, or the repairs or additions to, or alterations or extensions of existing buildings or structures, in either case involving in the aggregate a cost not exceedings $25,000; when approved in writing by the State Council of Defense or its duly authorized representatives.
12. Buildings begun prior to September 3, 1918, where a substantial portion of the building has already been constructed.

Section 2 of the order states that all limitations on the production of building materials are removed, and the material so produced may be sold and delivered for use in connection with any building project for which no permit or license is required.

Section 3 refers to the restrictions upon industries and manufacturers in their production and consumption of certain materials. These restrictions are now modified so that they are 50% less than the former restrictions. The commodities referred to include coal, coke and wood-burning cooking and heating stoves and ranges; gas ranges, water heaters, room heaters; hot plates and appliances; oil and gasoline heating and cooking devices; electrical heating and cooking devices; electric vacuum cleaners; electric fans (including motors); and builders' hardware.

According to Section 4, dealers (wholesale and retail) in raw materials, semi-finished and finished products are relieved from the obligation to give and require pledges relating to such commodities, except as limited by the other sections of the new order already mentioned. Such dealers, however, are relieved from the provisions in the pledges formerly required which made it necessary for manufacturers to exact pledges from those buying products for re-sale.

Section 5 states that the Priorities Division of the War Industries Board will assist industries in procuring materials, fuel, transportation and labor to enable them to increase their operations to normal limits as rapidly as conditions may warrant.

◆

The Last War Order of the War Industries Board.

As a matter of historical interest we present herewith the revised attitude of the War Industries Board toward non-war construction, with particular reference to granting federal licenses for houses for war workers, promulgated October 28, as representing the policy that would have been in effect if the war had continued.

In a circular on the subject the board called attention to the urgent need for the construction by private capital of houses for war workers and a plan was presented for licensing such projects which differed substantially from the normal procedure applying to non-war construction.

According to this plan, "home building committees" were to be constituted in certain localities. These committees were to gather together individual projects into groups, make application for collective federal building licenses and be responsible for the requisitioning of materials.

Such applications were to be approved by the United States Housing Commission. The "home building committees" were to be established by the State Councils and were to include a local representative of the State Council of Defense, a local representative of the Home Registration Service Bureau of the U. S. Housing Corporation (in communities where same is established), and a builder of broad experience. Provision was made for the addition of other members to this committee.

◆

Federal War Housing Subject of National Conference in Boston.

Government war-housing projects, government housing as a permanent policy and housing in the reconstruction period were subjects of consideration at the Sevnth National Conference on Housing in America, held in Boston, November 25-27. One of the speakers was Thomas Adams, town-planning advisor to the Commission of Conservation of Canada whose subject was "Housing and Reconstruction" with special reference to the reorganization of industry and the redistribution of labor following the demobilization of the army. Other questions on the programme for discussion were whether the government should continue its policy of building model villages and groups of houses in all parts of the country and how the improved housing standards set by these federal housing enterprises can be extended and maintained.

◆

Municipal Reconstruction in America.

For those interested in a reconstruction programme for American cities a valuable bibliography on the subject, including titles of magazine articles, British literature on reconstruction, and French books on reconstruction, has been prepared by the New York Public Library and published in Municipal Reference Library Notes for November 13, 1918. (Room 512 Municipal Building, New York.)

◆

Close of the War Will Not Stop Shipbuilding.

We are only now beginning our progress of ship construction. The removal of the emergency cannot and will not bring an end to the world's need for ship, nor prevent us from carrying out our program to a successful conclusion. We shall continue to use all the facilities of shipbulding that business economy will permit.

I mean by that, that all shipbuilders who live up to the expectations placed in them by the Government will be expected to continue to build ships. They shall be encouraged to do so. There will be plenty of work for every efficient yard.

On the other hand, the Government expects to continue to supply the material and direct the vast energies now devoted to shipbuilding. The end of the war will mean only the removal of the menace which confronted the world's shipping; it will not and cannot mean the immediate elimination of the need for ships.

To take advantage of this established industry and restore to the world its lost tonnage is a natural and business-like procedure. It offers America the chance now to serve humanity by putting ships on the high seas to carry materials for reconstruction, and to be of service to our own people and our allies.

So, I can say with frankness that our shipyards will be kept going to their capacity, and they must not let up.—Edward N. Hurley, chairman United States Shipping Board in the *Emergency Fleet News*, October 31, 1918.

Hold Your Liberty Bonds.

Some get-rich-quick concerns are endeavoring to persuade patriotic Liberty bond holders, whom they know will not sell outright their Liberty bonds, to turn over the Liberty bonds, to these companies as security for a loan and with the money thus borrowed purchase stock in their companies.

A Liberty loan bond is the safest investment in the world, and a prudent man will very carefully investigate any effort to induce him to exchange it for a less safe investment. This lending one money on Liberty bonds as security to purchase stock in the lender's company is in many cases only a thinly disguised method of exchanging stock of doubtful value for Liberty bonds of unquestioned value.

It is a good business and it is patriotism to hold your Liberty bonds.

War Savings Sales Near Billion Mark.

Including cash received in the Treasury Department on October 21 from the sale of War Savings securities, the total Treasury receipts from this source amounted to $801,453,415.86. This represents the purchase of War Savings stamps to the total maturity value of approximately $950,824,474.10.

The Largest Business Unit in The World.

Judged by almost any standard the Bureau of War Risk Insurance is probably the largest business unit in the world. In the twelve months just ended the bureau has mailed more than 6,500,000 checks in payment of allowances and allotments, representing a total disbursement of almost $200,000,000 for the care and maintenance of the families and dependents of our army and navy. During the same period the bureau has written nearly $35,000,000,000 of this insurance. The army and navy is more than 90 per cent insured and new applications are now being received for more than $1,000,000,000 of this insurance per week. The bureau has made awards and is paying monthly compensation on more the 5,000 death and disability claims and is paying monthly installments of insurance on more than 9,000 insurance death claims..

In the performance of this threefold task the bureau has within the year handled nearly 3,900,000 insurance applications and more than 3,800,000 allotment and allowance forms, and it has been necessary to prepare and mainain under constant control more than 26,000,000 separate individual card records. The bureau has received and answered more than 3,000,000 letters. From a small organization of twenty persons working in the basement of the Treasury Department, the bureau has grown until now is has a working force of 13,000 employees occupying thirteen buildings in Washington.

"America's Answer."

"America's Answer," a film production which is being exhibited through the Committee on Public Information, is described as the greatest war picture ever thrown on the screen. According to Charles S. Hart, director of the Division of Films, "America's Answer" takes one right into the heart of the world conflict shows how the American soldiers helped to wipe out the canker that was eating into the vitals of mankind. The government is taking an active interest in having this war picture shown in every city and town in the United States.

Effect of War on Air Conditioning Work.

A typical instance of the effect of the war restrictions in the air conditioning field is given by the Braemer Air Conditioning Corporation, Philadelphia, Pa., which reports that it was able to carry on its business successfully in spite of obstacles hard to overcome. During 1917, government restrictions regarding materials and labor were not so exacting as during the early part of this year. During the former period certain installations were made in buildings subsequently classified as non-essential.

During the summer of 1918 the company advised its agents and customers of existing conditions in the following notice:

"We are in full accord with the United States Government's restrictions regarding the furnishing of apparatus and materials for essential work only, but there is no way of our determining whether an inquiry relates to essential or non-essential work.

"Where the Government considers a project as essential, it will issue a priority certificate, and when this is secured by the owners or whoever has charge of the undertaking, and the number of the priority can be furnished us, we will gladly submit prices and assume a contract for apparatus of our manufacture, but not otherwise.

"Any quotations which we may have made or may make hereafter will be subject to these conditions, for the good of the cause, until the War is won."

To show the adaptability of air conditioning apparatus to various types of buildings and industries the company states that since April, 1917, installations have been made for the following industrial processes: Food products, chemical, steel, zinc, hardware, electric lamp, smelting and refining, glue, meat packing, electric light, storage battery, lithographing, hat manufacturing, and in explosive and municipal plants. Many of these installations were for cleansing and cooling the air used for the ventilation of generator coolers.

Well-water and refrigeration types of dehumidifiers entered into the construction of many of the equipments, not only for comfort, but for speeding up production and overcoming the deteriorating effect of bad atmospheric conditions. In some of the problems, dust removal and reclamation of products lost through exhaust pipes and humidification had to be taken care of, the plants being designed for winter use and the conditioned space maintained at the ideal point.

With the close of the war the prediction is made that the public will find that air conditioning is very much of an essential industry and the company looks forward to a busy period, especially in industrial lines, where efficiency, economy, comfort and speeding up of processes is desired.

◆

To Promote Better Relations Between Native and Foreign-Born Workers.

The Bureau of Education, Department of the Interior, is engaged in a movement to promote better relations between native and foreign born workers in industry. Trade publications reaching employers of labor will help in this service by presenting material in such form that employers can pass it on to their workers by means of the bulletin board, pay envelope, house organ or other medium. The plan is to publish brief articles in the trade publications under such a heading as "Put this on Your Bulletin Board" or one of similar meaning.

1919 Series of War-Savings Certificates and Stamps.

The Secretary of the Treasury, it is announced, has determined upon the issuance of a new series of war-savings certificates and stamps to be placed on sale early in 1919 and to be known as the series of 1919. They will have a maturity date of January 1, 1924. The same thrift stamps and thrift cards now in use will be continued in 1919 and will be exchangeable into new series of 1919 war-savings stamps payable January 1, 1924, in the same way as the exchange has been made during this year.

◆

Killed in Action.

Thomas R. Montgomery, of the accounting department of James B. Clow & Sons, Chicago, was killed in action October 1, at Cambrai, France. He was attached to the Canadian cavalry.

Lieutenant Harry A. Gross, Jr., of the Minneapolis branch of the American Radiator Company, was killed in action in France September 8. He was in charge of a machine gun battery when he met his death. He enlisted in May, 1917, with the marines and was one of four men who were known as the "heating squad," the others being Privates Bevington and Porter, American Radiator Co.; Private Olson, Kewanee Boiler Co.; and Private Drury, Mehring & Hanson Company. Lieutenant Gross was later transferred from the U. S. S. Nebraska to the Officers' Training Camp, at Fort Sheridan, Ill., where he obtained his commission.

◆

Results of Daylight Saving Law.

According to the United States Fuel Administration's estimates, 1,125,000 tons of coal were saved by turning the clocks ahead one hour for seven months. Definite reports from St. Louis show a saving of 17.5 tons for each thousand of population on the seven months' basis.

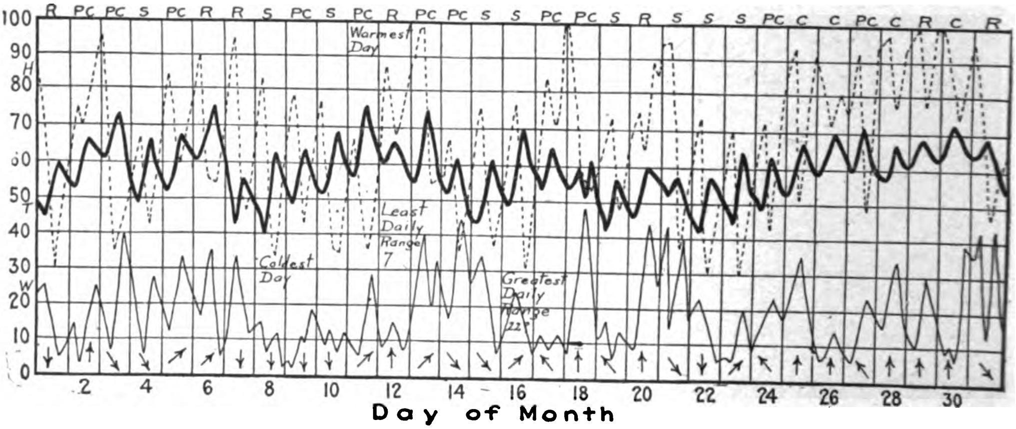
The saving in France for a three months' period was 250,000 tons, which would make a saving of 12.5 tons for each thousand of population for a seven months' period.

◆

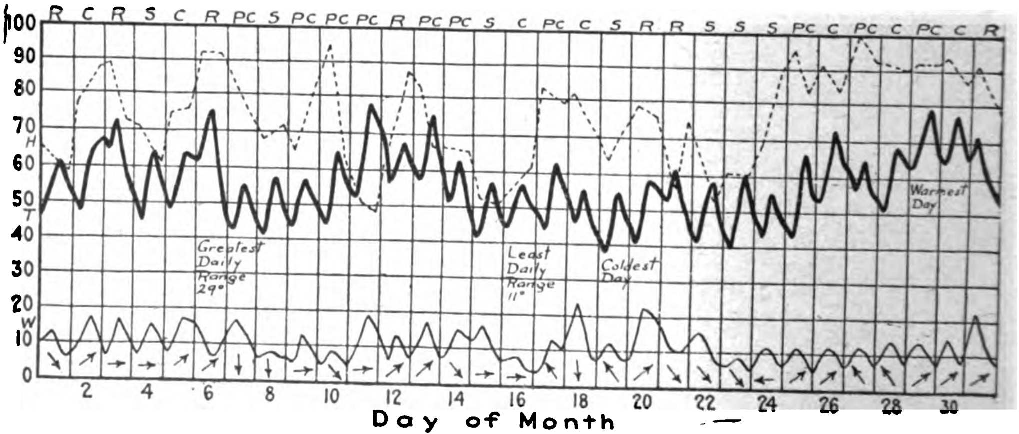
Osborn Monnett, of the smokeless boiler department of the American Radiator Company, is serving as a member of the Illinois Section of the Conservation Division of the United States Fuel Administration.

THE WEATHER FOR OCTOBER, 1918

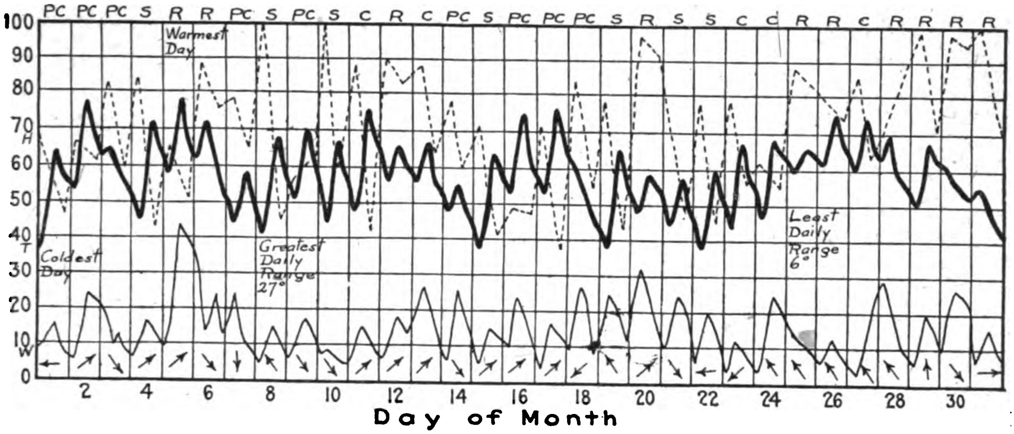
	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest temperature, degrees F.	75	79	78	80	88
Date of highest temperature	11	29	5	5	5
Lowest temperature, degrees F.	40	38	38	37	41
Date of lowest temperature	8	19	1	31	31
Greatest daily range, degrees F.	22	29	27	26	25
Date of greatest daily range	16	6	8	15	27
Least daily range, degrees F.	7	11	6	3	5
Date of least daily range	12	16	25	23	19
Mean temp. for month, degrees F.	58.6	56	58	57.4	62.3
Normal mean temp. for month, degrees F.	55.6	52.3	54.9	53.2	58.4
Total rainfall, inches	0.83	0.99	3.08	2.94	3.63
Total snowfall, inches	None	None	None	Trace	None
Normal precipitation, this month, in.	3.71	3.86	2.36	2.55	2.41
Total wind movement, miles	11444	6610	7370	8936	8766
Average hour wind velocity	15.4	8.9	9.9	12	11.8
Prevailing direction of wind	S.	.W.	S.W.	S.W.	S.
Number of clear days	10	8	7	9	15
Number of partly cloudy days	14	12	19	11	4
Number of cloudy days	7	11	14	11	12
Number of days on which rain fell	8	7	10	12	6
Number off days on which snow fell	---	---	---	1	---
Snow on ground at end of month, in.	---	--	---	---	---



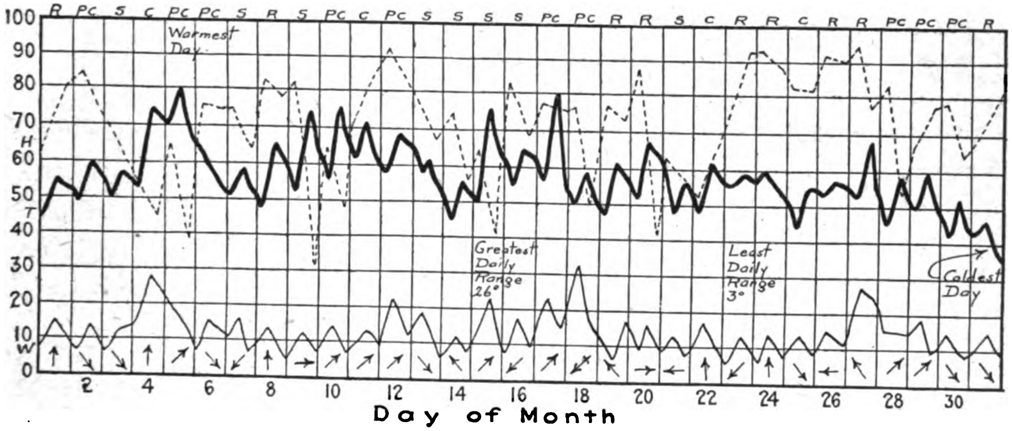
RECORD OF THE WEATHER IN NEW YORK FOR OCTOBER, 1918.



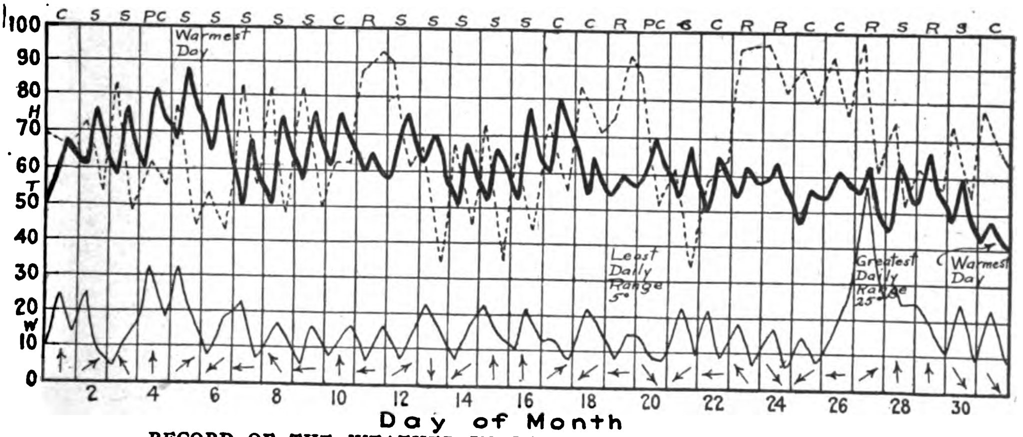
RECORD OF THE WEATHER IN BOSTON FOR OCTOBER, 1918.



RECORD OF THE WEATHER IN PITTSBURGH FOR OCTOBER, 1918.



RECORD OF THE WEATHER IN CHICAGO FOR OCTOBER, 1918.



RECORD OF THE WEATHER IN ST. LOUIS FOR OCTOBER, 1918.

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.

Heavy lines indicate temperature in degrees F.

Light lines indicate wind in miles per hour.

Broken lines indicate relative humidity in percentage from readings taken at 8 A. M. and 8 P. M.

S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.

Arrows fly with prevailing direction of wind.

Recent Steam Trap Tests.

An effort to determine the actual capacities of steam traps at different pressures was made during the past year by the meter committee of the National District Heating Association and reported in the Association's Bulletin. The committee points out that the inconsistency of the old method of choosing a trap according to the size of its inlet connection is now generally appreciated and the necessity recognized of selecting it upon the basis of its actual capacity.

Four different types of low-pressure float traps were tested. The method adopted was to run water through the trap under a constant pressure and measure the actual weight of water discharged. The pressure was measured in the trap itself and was maintained at the required point by means of an overflowing standpipe of the proper height.

Special attention is called to the fact that the quantities obtained in this manner represent the maximum capacity of the trap and are taken with the trap flooded, a condition which is seldom desirable during actual operation. The allowable working capacity of the trap is a function of this maximum capacity, however.

No attempt has been made to set forth a different schedule of ratings from those given by the manufacturers, but the published ratings are given with the test results for purposes of comparison.

STEAM TRAPS CONSERVATIVELY RATED BY MANUFACTURERS.

A study of the results as given, states the commitee, leads to the conclusion that all of the traps tested are rated very conservatively by the manufacturers. The desirability of using, for a given service, a size of trap which will work more nearly up to its actual capacity, will depend largely upon local conditions, as, for instance, upon the regularity of flow of the condensation, etc. The data herein given should prove to be of assistance in the selection of the proper size of any of the traps tested.

The tests recorded were made with pressures of 1 lb. and 5 lbs. at the trap, and it was found that the quantity of water discharged varied directly as the square root of the pressure, as would be expected. The capacity of a trap for any pressure can then be obtained by making use of that relation.

Another important fact brought to light

EMPIRE STEAM TRAP.
(American District Steam Co.)

Size No.	Pipe Size of Inlet, Inches	Pipe Size of Outlet, Inches	Diameter of Valve, Inches	Diameter of Stem, Inches	Net Valve Area, Sq. Inches	Manufacturer's Rating, Sq. Ft. of Radiation at 1 Pound Pressure	Maximum Capacity, Pounds Per Hour: 1 Pound Pressure	Maximum Capacity, Pounds Per Hour: 5 Pounds Pressure
00	¾	¾	.250	.126	.035	500	520	1,152
0	1	¾	.312	.126	.064	600	890	1,800
1	1¼	1	.437	.134	.135	1,700	1,315	2,990
2	1½	1¼	.512	.168	.226	2,800	2,860	6,095
3	2	1½	.687	.168	.349	4,600	4,160	9,150
WRIGHT SPECIAL HEATING TRAP. (Wright Manufacturing Co.)								
0	¾	¾	.437	.187	.123	500	1,125	2,590
1	1	1	.500	.187	.221	1,000	2,020	4,892
2	1¼	1¼	.625	.187	.279	1.650	3,040	7,000
3	1½	1½	.687	.187	.343	3,000	3,700	8,476
4	2	2	1,000	.187	.758	4,000	6,880	15,917
5	2	2	1,125	.187	.966	6,000	9,550	19,770
ANDERSON MODEL D STEAM TRAP. (V. D. Anderson Co.)								
1	½	½	.500	....	.196	1,000	1,128	2,232
2	¾	¾	.750	....	.442	1,600	2,033	3,880
3	1	1	1.000	....	.785	2,600	2,532	4,917
4	1¼	1¼	1.250	....	1.227	4,700	3,327	6,852
5	1½	1½	1.500	....	1.767	7,000	5,096	11,796
6	2	2	2.000	....	3.142	10,000	7,344	16,648
7	2½	2½	2.500	....	4.909	20,000	11,950	26,482
AMERICAN IDEAL STEAM TRAP.* (American Steam Gauge & Valve Co.)								
1	½	½	.500	....	.196	1,160	1,960	4,380
2	¾	¾	.750	....	.442	1,720	2,920	6.640
3	1	1	1.000	....	.785	2,800	4,730	10,530
4	1¼	1¼	1.250	....	1.227	4,310	7,270	16.200
5	1½	1½	1.500	....	1.767	6,100	10,360	23,400

* The capacities given in this table are those published by the manufacturer. They have been verified for the No. 1 size trap by the committee by test.

by the tests is that the capacity of the trap does not depend entirely upon the net valve area, the construction of the valve having an appreciable effect. For example, in traps whose valve stems were equipped with a spider intended to guide the valve, the capacity per unit of net valve area is less than in traps not having this feature, indicating that this obstruction reduces the discharge capacity.

◆

Records Show Value of Intermittent Heating in Steam-Heated Buildings.

One of the subjects covered in the report of the Public Policy Committee of the National Disrict Heating Association is the question of economies possible in shutting down the steam heating plants in large buildings during the night. In discussing the report in the October issue of the Association's Bulletin, J. H. Walker cites a typical case where a marked reduction in the amount of steam used was obtained by intermittent heating.

"While it is true," he says, "that upon turning on the heat into a cold building steam is condensed at a high rate for a short period, possibly necessitating, in the case of an individual heating plant, the forcing of the boilers to an economical rating, it is doubtful if even this effect is sufficient to offset the saving gained by intermittent operation.

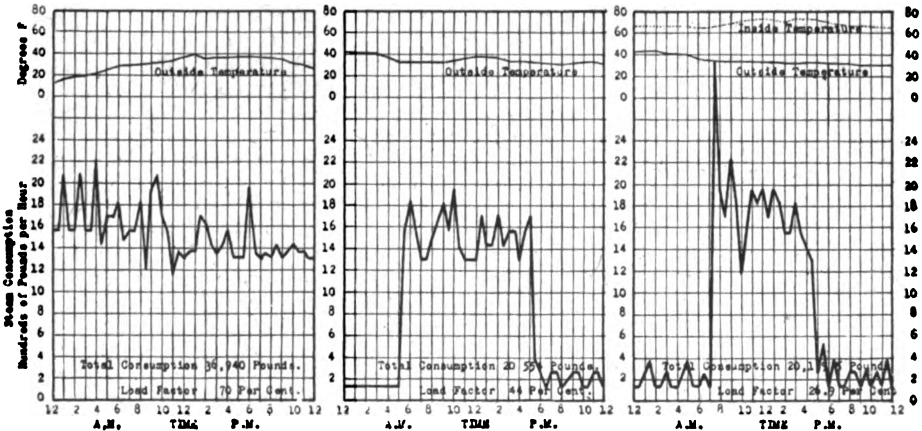
"An example of the effect of shutting off steam at night is shown in the accompanying curves which are actual load curves of a medium-sized office building taken under each method of operation. In Fig. 1 the steam was left on during the night and the amount of steam consumed was 36,940 lbs. In Fig. 2 the heat was shut off at night, except in certain parts of the building which were supplied by a separate main, and the amount of steam used was 20,554 lbs., or 55.5% of the amount used in the former case. The outside temperature on the former day was slower, making the actual net saving somewhat less than this.

In many buildings it is impossible to operate the heating system in this manner, however. Parts of the building may be occupied at night, and the lack of a separate supply main makes it necessary to keep the entire building heated. Also, in modern steel-frame buildings, whose thermal capacity is comparatively low, the excessive cooling of the building during the non-heated period may endanger the plumbing, particularly if it is near the outer walls. These factors should be considered in the design of buildings, for it is no more logical, and far more costly, to heat an unoccupied building than to keep it brilliantly lighted.

In large buildings equipped with a vacuum system and in which it is not feasible to shut off the heat entirely, some economy can be effected by increasing the vacuum and thus reducing the temperature of the radiator surfaces. In one Detroit building in which this scheme is used the rate of steam consumption at night is about 80% of the rate during the day.

The idea presents itself that a system of thermostatic control could be devised which would automatically reduce the building temperature during the period of non-occupancy. Possibly the present forms of compressed air thermostat could be modified so as to accomplish this.

Another phase of the subject, entirely



February 6,1918.
Figure I.

March 13,1918.
Figure II.

February 28,1918.
Figure III.

RESULTS OF CONTINUOUS AND INTERMITTENT HEATING IN OFFICE BUILDING.

apart from the matter of fuel conservation, is the effect of the proposed method of operation upon the load curve of the central (heating) station. The load factor of the curve in Fig. 2 is 44%. In Fig. 3 is shown a load curve for the same building in which the sudden turning on of steam resulted in a divided peak, giving a load factor for that day of only 26.7%. Similar peaks occurred on several other days when load curves for this building were taken. Would the summation of large numbers of similar curves such as this from different buildings results in a disastrous peak, or would there be sufficient natural diversity in them to render the resultant station peak less sharp? It is probable that the latter would be true, for the time of turning on would vary considerably according to the length of time necessary to warm the building. On the very coldest days there would probably be a less noticeable peak because of the fact that many buildings would not be shut off during the night in such weather.

The real result, however, would unquestionably be a decrease in the amount of steam sold and an increase in the plant capacity required per square foot of connected radiation. This would increase the relative value of the so-called "demand" portion of the cost of service and might necessitate a demand charge based upon the actual peak.

That shutting off at night is productive of economy in the use of heat, however, is a fact concerning which there is no room for doubt.

◆

Pipe Bending as a Separate Line in the Heating Industry.

For many years heating contractors have felt very keenly the need of having pipe bending done at home. The inconveniences and loss of time and freight delays have been a handicap.

In Cleveland this situation has been met by the organization of the Ohio Heating and Pipe Bending Company which, for the past two months, has been running night and day and reports work ahead for many weeks to come. This company was organized by Peter J. Schomers as the Schomers Heating & Ventilating Co., with a capital stock of $100,000, specializing in pipe bending and marine equipment and repair. Peter J. Schomers, the head of the concern, was for 18 years with the American Ship Building Co., of Cleveland.

The pipe bending department soon grew ··ıch proportions that the company, on changing its name, was obliged to seek larger quarters at 1061-1063 West 11th Street, comprising 30,000 sq. ft. of floor space. The company is now installing two more large bending tables, 12 x 14 ft., including the furnaces for same. Each member of the organization, it is stated, is a specialist in his own line and the company's equipment places it in a position to render valuable service to the heating trade of Cleveland.

◆

Limitations of Humidifying Devices in Warm-Air Furnaces.

It is common to find in warm-air furnace literature the statement that the water-pan furnished with the heater and usually located in the furnace casing at about the level of the fire-door "will give the necessary amount of moisture to the air." The repetition of this statement in a recently-received circular led to an inquiry as to how much water is actually evaporated with a pan in the location stated. The reply brought out some interesting comments, not only on this point, but also on the use of pans placed above the dome of the furnace.

"The water pans in the present-day warm-air furnace," states this manufacturer, "are of no particular avail regardless of whether they have an automatic float or not. It is not a question of automatic water supply, it is a case of automatic humidification. When a pan is set on the dome of a furnace and an extreme temperature raised, the evaporation frequently is excessive. We found a case last winter where an owner became very enthusiastic regarding humidification and was under the impression that there was no limit. His wife, however, complained very bitterly that the house furnishings were damp and even moist to such an extent, in some cases, that it was unpleasant to place the hands on the arm of a rocker. After many trials he finally concluded that the method we employ (water-pan at level of fire-door) was the most practical.

"Many manufacturers call especial attention to the excessively large water-pan they furnish, which, we think, is an error. The location of our water-pan is such as to afford an opportunity to adjust the pan to obtain a humidity in the house that will work out with the wet bulb.

"We believe you will agree with us that it will require less heat to bring 2 gal. of water to the vapor point than it will to bring 4 or more gallons to the same point. Our water-pan is tapped on two sides for pipe connections and we anticipate placing an automatic float thereon when conditions become normal again We were one of the first manufacturers to come out with such an arrangement a number of years ago and while we have not employed the float to date, we have been advocating that the installer make a direct water-pipe connection with the vapor pan and place a ⅜-in. Jenkins' disc globe valve on the line. By cracking the valve the water will drip into the pan in such small quantities as not to reduce the vapor stage in the water, whereas the automatic float allows a considerable quantity to be admitted into the water-pan at one time. When low fires are running, it takes considerable time to reach the vapor point again."

The company states that it will conduct a number of tests during the winter with its form of water-pan and hopes to be able to furnish us before long with authentic data regarding the actual evaporating capacity of the pan under varying conditions.

◆

Features of Heating System at Westinghouse Essington Plant.

An idea of how the indirect heat outlets are arranged in the new Essington plant of the Westinghouse Electric & Mfg. Co., which was described in the November issue, is given in the accompanying illustration, Fig. 1. This shows a typical outlet in one of the shop buildings.

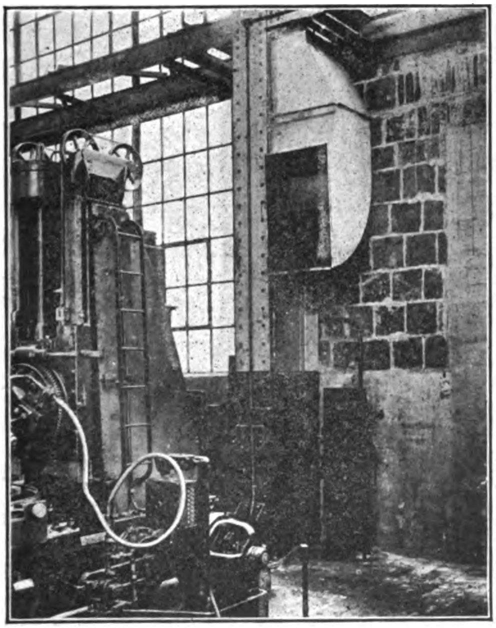


FIG. 1—ARRANGEMENT OF INDIRECT HEAT OUTLETS, WESTINGHOUSE ESSINGTON PLANT.

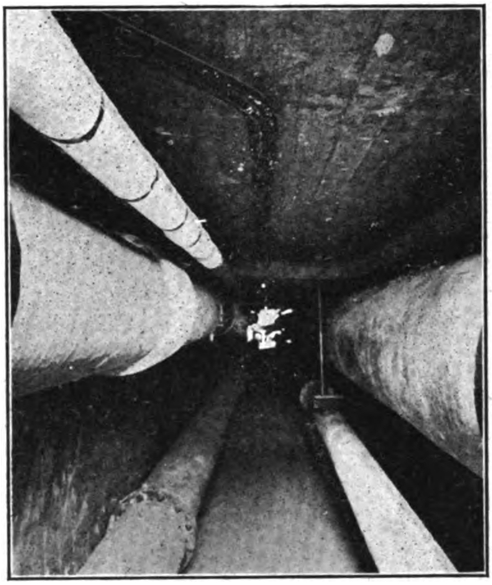


FIG. 2—SECTION OF PIPE TUNNEL, WESTINGHOUSE ESSINGTON PLANT.

Steam for the heating system is supplied through large exhaust mains in tunnels to the different buildings and the water of condensation is drawn through the return mains by vacuum pumps located in the power house. Fig. 2 shows a typical section of one of the tunnels.

◆

New Movement to Standardize Screw Threads.

Many of the old-timers in the trade, who went through the mill when the Briggs standard of screw threads was established, rubbed their eyes recently and read the news again that a new commission had been authorized by Congress and appointed by the Secretary of Commerce under date of September 21, 1918, "for the standardization of screw threads." As stated in the act, the duties of the commission are to ascertain and establish standards for screw threads which shall be submitted to the Secretary of War, the Secretary of the Navy and the Secretary of Commerce for their approval. These standards, when approved, shall be adopted and used in the manufacturing plants under the control of the War and Navy Departments and, so far as practicable, in all specifications for screw thread proposals for manufactured articles, parts or materials to be used under the direction of these departments. It is also intended by the bill that the Secretary of Commerce shall promulgate such standards for use by the public and publish the same as a public document."

Hearings on the subject were arranged to be held in New York, Dayton, Detroit, Washington and in other places. The first hearing was held at the Engineering Societies, New York, October 7, and was attended by many manufacturers and users of screw thread products. Accompanying the notice of the hearings were topics for discussion, compiled by the National Screw Thread Commission of which S. W. Stratton is chairman. Mr. Stratton is also head of the Bureau of Standards, in Washington.

Topic No. 1 was a query whether there is any objection to the adoption of the American Briggs pipe-thread sizes for both taper and straight pipe threads.

Topic No. 2 referred to the experiments on the form of pipe threads conducted by the Pennsylvania Railroad in connection with the American Society of Testing Materials which "tend to show the desirability of the U. S. Standard form with flat top and bottom one-eight of the pitch" and asked if it was advisable to adopt the U. S. Standard form, instead of the present form which specifies a thread depth of 0.8 in. of the pitch, with a resulting flat at the top and bottom of the thread which is quite small.

Topic No. 3 asked to what extent gauges for checking pipe threads were used in shop practice and what is considered a satisfactory tolerance for ordinary commercial work stated in turns either way from the gauging notch.

The suggested topics also referred to the threading on brass tubing, hose couplings, Acme and other special threads used in machine construction, and instrument threads.

In commenting on the discussion brought out at the hearing a well-known engineer in attendance writes:

"Without exception the opinions were all in favor of maintaining the Briggs standard which has become known as the American Briggs standard (A. S. M. E.) and is now used universally in American and Canadian practice and is known the world over. It would be a calamity to change this standard as the entire manufacturing interests of this country and Canada recognize it and follow it in all their pipes, fittings and valves."

"Practically without exception," continues our correspondent, "every man who gave evidence agreed that the country's standard should not be changed and particularly so at this time and that the War and Navy Departments will be better served by the present popular standards with which all are acquainted than with some new and untried standard. This view applies, to steam, water, air and gas pipes.

"As far as hose couplings are concerned there should be uniformity which does not now exist and the appointment of the commission will be justified if they give us interchangeable hose couplings for fire and water."

As our correspondent points out, a committee of the A. S. M. E., of which he was a member, worked for nine years previous to the beginning of the war in 1914 as a member of the International Commission for an international pipe-thread standard. This international commission would have made its report in October, 1914, had not the European war broken out and its nine pears' labor will be in vain if the American Briggs standard is not adopted as a universal standard throughout the world. The United States committee's efforts were crowned with success to such an extent that the United States, Great Britain, France and nearly all of the other European powers had agreed on a standard so close to the American Briggs that there was no material difference in size, pitch or diameter from the present American and English pipe standards. In his opinion, a universal pipe-thread standard will be set back a generation or more if this country shows that it is not satisfied with its own standard.

◆

Arrangement of Standard Heating and Ventilating Data Sheets.

Numerous requests from our readers that we publish the data sheets that are appearing in THE HEATING AND VENTILATING MAGAZINE each month in consecutive order, rather than apparently at random, prompt us to give herewith the scope covered and to be covered by these sheets. As was stated in a previous issue, some subjects, such as radiators, will occupy no less than 50 or more sheets and it was with a view of avoiding the monotony of a large number of sheets on the same subject that the sequence was varied. Eventually the entire compilation will be published and it will be seen that the sheets have been numbered and arranged in definite order:

Following is the schedule that is being followed:

No. 1. B. T. U. losses.
No. 2. Exposure.
No. 3. Leakage.
No. 4. Temperature range.
No. 5. Computing heat losses.
No. 6. Blank.
No. 7. Ventilation.
No. 8. Air changes.
No. 9. Air.
No. 10. Ducts and flues.
No. 11. Duct and flue details.
No. 12. Symbols.
No. 13. Direct radiation.
Nos. 14-32 (inc.) Direct radiators.
No. 35. Pipe coils.

Nos. 36-37. Indirect radiators.
Nos. 38-42. Cast-iron blast heaters.
Nos. 44-48. Pipe coil blast heaters.
Nos. 50-70. Cast-iron boilers.
No. 71. Steel fire box boilers
No. 82. Horizontal return tubular boilers.
No. 83. Water-tube boilers.
Nos. 90-94. Boiler accessories.
No. 100. Chimneys.
No. 101. Forced draft.
No. 102. Forced draft apparatus.
No. 105. Steel pipe.
No. 107. Standard weight flanged pipe fittings.
No. 108. Extra-heavy flanged pipe fittings.
No. 110. Pipe coverings.
Nos. 111-124. Valves.
No. 128. Flow of steam in pipes.
No. 129. One-pipe steam system.
No. 130. Two-pipe steam system.
No. 131. Vacuum steam systems.
No. 132. Vapor systems.
No. 133. Gravity hot-water heating.
No. 134. Forced hot-water heating.
Nos. 136-150. Fans.
No. 165. Special fans.
No. 168. Belt and chain drives.
No. 169. Exhauster systems.
No. 170. Chemical exhausts.
No. 171. Forge blast and exhaust.
No. 175. Humidity.
No. 176. Air conditioning in industries.
No. 177. Air washers.
No. 190. Temperature control.
No. 200. Boiler-feed pumps.
Nos. 202-207. Feed-water heaters, open.
No. 208. Water weighers.
No. 209. Coal scales.
No. 210. Feed-water heaters, closed.
No. 212. Separators, steam.
No. 214. Separators, oil.
No. 220. Traps.
No. 221. Return trap dimensions and capacities.
No. 245. Hot-water service heaters.
No. 250. Cost data.
Nos. 275-279. Miscellaneous tables.

It will be noticed that blanks are left here and there. This is to provide for the insertion of additional sheets, if necessary. In this connection, readers are invited to send in suggestions for data not covered in the foregoing schedule.

◆

New Sliding Scale Rates for Central Station Heating.

A service has been rendered to the district heating industry by the compilation by Howard E. Long of a revised list of rates for central station heating, based on metered service. The compilation is published in bulletin form (Bulletin No. 148) by the American District Steam Co., North Tonawanda, N. Y. The company states that the bulletin has been in preparation for some time and is accomplished through the courtesy of the various central station heating companies. It is published in loose-leaf form so that new rates or amended rates may be included.

The Cities covered in the bulletin are:

Albia, Ia.; Anderson, Ind.; Atlanta, Ga.; Auburn, N. Y.; Aurora, Neb.; Aurora, Ill.; Baltimore, Md.; (two companies); Beaver Dam, Wis.; Birmingham, Ala.; Bloomington, Ill.; Boston, Mass.; Brandon, Man.; Butte, Mont.; Casper, Wyo.; Canton, Ill.; Canby Minn.; Cedar Rapids, Ia.; Champaign, Ill.; Chadron, Neb.; Cheyenne, Wyo.; Chicago, Ill.; Clarinda, Ia.; Clinton, Ill.; Coatesville, Pa.; Colorado Springs, Colo.; Crawford, Neb.; Danville, Ill.; Davenport, Ia.; Dayton, O.; Dekalb, Ill.; Detroit, Mich.; Decatur, Ill.; Eagle Grove, Ia.; Easton, Pa.; Erie, Pa.; Evansville, Ind.; Eveleth, Min.; Excelsior Springs, Mo.; Galesburg, Ill.; Geneva, Neb.; Geneva, N. Y.; Glenwood, Minn.; Grand Forks, N. D.; Grand Rapids, Mich.; Grinnell, Ia.; Hazelton, P.; Hillsboro, Ill.; Huntington, Ind.; Indianapolis, Ind.; (two companies); Jamestown, N. D.; Johnstown, Pa.; Kansas City, Mo.; Kewanee, Ill.; Kitchener, Ont.; Kokomo, Ind.; Lamar. Colo.; Laramie, Wyo.; Lima, O.; Lincoln, Neb.; Little Rock, Ark.; Lockport, N. Y.; Manchester, Ia.; Marion, Ia.; Maryville, Mo.; Mexico, Mo.; Milwaukee, Wis., (two companies); Mineral Point, Wis.; Minot, N. D.; Missoula, Mont.; Monmouth, Ill.; Morrisonville, Ill.; Nashua, N. H.; Newburg, N. Y.; New York City; Norristown, Pa.; O'Neill, Neb.; Oskaloosa, Ia.; Ottumwa, Ia.; Oxford, Pa.; Paducah, Ky.; Pawtucket, R. I.; Paxton, Ill.; Pekin, Ill.; Penn Yan, N. Y.; Peoria, Ill.; Pittsburgh, Pa.; Pittsfield, Mass.; Portland, Ore.; Port Jefferson, N. Y.; Rochester, N. Y.; Saginaw, Mich.; Salt Lake City, Utah; San Francisco, Cal.; Scottsbluff, Neb.; Seattle, Wash.; Sedalia, Mo.; Shenandoah, Pa.; Shenandoah, Ia.; Sioux City, Ia.; South Bend, Ind.; Spokane, Wash.; Springfield, Mo.; Springfield, O.; St. Paul, Minn.; St. Joseph, Mo.; Streator, Ill.; Sycamore, Ill.; Taylorville, Ill.; Topeka, Kan.; Towanda, Pa.; Washington, Pa.; Waterloo, Wis.; Waukesha, Wis.; Wayne, Pa.; West Bend, Wis.; Wilkes-Barre, Pa.; Worcester, Mass.; Yakima, Wash.; York, Neb.; York, Pa.; and Youngstown, O.

CORRESPONDENCE

Figuring Fume Extraction Problem.

EDITOR HEATING AND VENTILATING MAGAZINE:

In many fume extraction jobs, due to the nature of the fumes, it is essential that they should not pass through the fan. Under these circumstances the ejector chimney is used with a high-pressure fan. For the sake of argument it is assumed that 3000 cu. ft. of fumes (for density, say, air at 70° F.) has to be moved per minute and the frictional resistance up to the base of the chimney is ¾ in. w. g. What quantity of air at what water gauge will be required from the nozzle to ensure this movement? What governs the shape of nozzle and throat of stack? Is this equal to the "equivalent area," as laid down for fan work?

REPLY BY B. S. HARRISON.

As stated the problem is to move 3000 cu. ft. per minute of fumes or gases at 70° F. and of the same density as air at that temperature, through a stack without passing same through a fan, the maintained friction of this system up to the point of entering the stack being 0.75 in. water column, or, say, 0.43 oz. per square inch.

There are three elements of power to be considered:

1. The power to put the air in motion.
2. The power to keep the air in motion.
3. The power to overcome the fric

As we do not know the height of discharge chimney of stack, we shall assume it to be without friction, the total frictional resistance of the system being assured, or 0.43 oz. per square inch up to the base of the stack.

We will assume that we are to deliver the gases through the stack at a velocity of 1200 ft. per minute, or 20 ft. per second; also that we are going to use 1000 cu. ft. of fresh air per minute through the fan to induce this action.

The stack must then deliver 3000 cu. ft. of gases, plus the 1000 cu. ft. of air, or a total of 4000 cu. ft. of gas and air combined.

The total H. P. of work done will be:

$$\frac{WV + \frac{1}{2} MV^2 + \text{frictional loss in pounds} \times \text{area in sq. in.} \times V}{500}$$

W being weight in pounds per second.

V being velocity in feet per second.

$$\therefore WV = 5.12 \text{ lbs.} \times 20 = 102.4$$

$$\tfrac{1}{2} MV^2 = \frac{5.12}{64.4} \times 400 = 32.0$$

$$\frac{0.43}{16} \times 3.3 \times 144 \times 20 = \underline{255.6}$$

$$390$$

$$\frac{390}{550} = 0.7 \text{ H. P.}$$

Now this 0.7 H. P. must be supplied by means of the 1000 cu. ft. of air per minute from the fan.

Assume that a compound nozzle form is used at the base of the stack, of the converging diverging type recognized as most efficient, and that the total efficiency of same is 70%. Then the input, or H. P. applied at the nozzle must be $\frac{0.7}{70\%}$ or 1 H. P.

Therefore the 1000 cu. ft. of air per minute from the fan must deliver 1 H. P. at the nozzle, or 550 ft. lbs, per second.

1000 cu. ft. per minute = 16.2 cu. ft. per second, or 1.28 lbs. per second.

$$550 = 1.28\,V + \frac{1.28}{64.4}\,3V^2$$

$$550 = 1.28\,V + 0.02\,V^2$$

$$571 = 21 + 1.28\,V + 0.02\,V^2$$

$$32.6 = 4.5 + 0.1415\,V$$

$$28.1 = 0.1415\,V$$

NOTE: These figures are not accurate to decimal places, but are approximately correct.

∴ V = 200 ft. per second, or 12,000 ft. velocity per minute.

Therefore the fan must deliver 1000 cu. ft. of air per minute through the nozzle and while doing so maintain a total pressure of 5.38 oz. per square inch at nozzle. Whether or not the fan is delivering within its "square inches of blast" depends upon its type and capacity and the speed at which it is run.

◆

Measuring Air Delivered Through Mushroom Ventilators.

EDITOR HEATING AND VENTILATING MAGAZINE:

Can you advise me of a satisfactory method of measuring the air delivered through mushroom ventilators by means of anemometer readings in a theatre installation? For the mushrooms on the auditorium floor, it is easy enough to measure the air by using the anemometer in the intake to the mushrooms, as the plenum space under the auditorium is accessible. On the balcony floor, however, the plenum space is not accessible, and hence the reading must be taken at the outlet of the mushrooms.

If one were to set a stove pipe about 8 in. or 10 in. in diameter and, say, 8 in. high, over the mushroom and read the flow at the upper outlet of the pipe, will the results be correct? If not, what percentage of error will result, due to the friction in the pipe? All other mushrooms except the one where readings are being taken are, of course, unencumbered. Your advice upon this matter will be greatly appreciated.

Seattle, Wash. E. L. W.

We would suggest the use of a paper cone, the small end of which is the exact diameter of the anemometer used and the large end of sufficient diameter to be at least 6 in. distant from the mushroom outlet all around the circumference. While this method will not perhaps give results which are absolutely accurate, owing to the fact that there will be leakage around the bottom of the cone and a certain amount of resistance caused by the obstruction of the anemometer over the cone outlet, it is quite likely that the error will be less than that caused by the anemometer itself which, as is well known, is far from being absolutely correct. It is believed that the foregoing method will give satisfactory results for practical purposes. To obtain anything more accurate would require the use of a Pitot tube.

◆

Steam Specialties, described as a book full of ideas and data on steam plant operation, has just been issued by the Wright-Austin Co., Detroit, Mich.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Date Fixed for Annual Meeting.

The dates for the annual meeting of The American Society of Heating and Ventilating Engineers have been fixed for January 28-30, 1919, with headquarters at the Engineering Societies Building, 29 West 39th Street, New York. With the close of the war and the revival of general business activity, an unusually large attendance is looked for that will reflect the importance of the new times and conditions.

New York Chapter Discusses Engineering Economics of Heating.

Under the title of "Engineering Economics of Heating," M. W. Ehrlich addressed the New York Chapter, at its November meeting, November 18, showing a number of charts he had developed on the coal requirements of buildings, either with steam or hot water heating systems, based upon varying outside weather conditions. Mr. Ehrlich's charts were the result of observations of the plants of several hundred buildings, including many of modern type.

He showed that in a climate like that of New York a heating plant designed on a "zero to 70" basis operates at an average of 42% of its capacity so that there is a large reserve capacity that is only needed at infrequent intervals. During the past exceptionally severe winter, for instance, there were only 96 hours of zero weather in New York. The charts showed by months how the load requirements run up from the opening of the heating season to the peak load in January and down again through the spring months. These were supplemented with charts showing the corresponding proportion of coal requirements month by month, so that it was possible to check the coal used in a given building for any period. An alignment chart was then presented which could be applied to any building and the season's coal requirements read directly for varying outside or indoor temperatures, or both.

In discussing the charts George W. Martin, president of the National District Heating Association, told of the difficulty of obtaining results that would harmonize with theory and said that in a number of buildings where he had maintained records it was impossible to reconcile the coal used with any theory of what should have been required.

Mr. Ehrlich then explained that his charts were intended to form a basis so that in a given case where the coal consumption ran above the calculated amount, it would mean that something was wrong with the plant or its operation.

President P. H. Seward of the New York Chapter said he believed Mr. Ehrlich's paper marked an advance and while more or less modification might become necessary in the basis he had used, it was his opinion that in the years to come some such method would become common practice in the trade. The old days, he said, of uncertain heating plant operation were rapidly coming to an end and we are at the beginning of a conservation era that will put wasteful practices in the discard. He said that the days of sharp competition were about to return and he looked for a period that would tax the recources of the trade and profession to produce economical as well as correctly-designed apparatus.

Previous to Mr. Ehrlich's address stereopticon views were shown of "The American Soldier in the Making." President Seward then announced that the plans of the society's research bureau committee were being rapidly perfected and he called upon Mr. Lyle to tell of the progress of this work.

Mr. Lyle stated that some 2000 names of firms in the heating and ventilating line had been card indexed with an allotment placed alongside each name. The committee's plan calls for the raising of $10,000 each year for a period of five years to operate the bureau. No allotment, he said, would exceed $250.00 per year and that if the trade responded as was expected, the average allotment would be a nominal figure. Sub-committees have already been named to canvass the trade and in addition, Mr. Lyle stated that a number of the society's members including President F. R. Still, W. F. McDonald, of Detroit; E. E. McNair, of Detroit; H. M. Hart, of Chicago; and himself, were about to visit the principal cities in the middle west in the interests of the project. The campaign would be opened December 2 and would continue until January 18. Sub-committees have already been named to canvass the trade, that for the New York district being made up of Arthur Ritter, chairman, and Messrs. F. K. Chapman, J. A. Donnelly, C. E. Pearce, G. G. Schmidt, C. E. Scott and B. K. Strader.

Illinois Chapter Postpones Meeeting.

Owing to the influenza epidemic in Chicago the November meeting of th Chapter was postponed.

British Institution of Heating and Ventilating Engineers.

At the autumn meeting of the Institution of Heating and Ventilating Engineers, which was held at the Duke's Salon, Holborn Restaurant, London, October 8, a paper was presented by M. Kinoshita on "A New Method of Testing Heat Transmission from Radiators." The report of the institution's research committee was also considered, as well as extracts from the report dealing with "The Transmission of Heat Through Heavy Building Materials."

This investigation was conducted for the research committee of the Institution of Heating and Ventilating Engineers, with the aid of grants from the Department of Scientific and Industrial Research of the University of London, and the report was issued under the authorship of Arthur H. Barker, director of laboratory, and M. Kinoshita, assistant. The experiments described in the report were undertaken to develop standard methods of testing heat transmission through thick walls, to compare the transmission coefficients for different materials under precisely defined standard conditions, to verify the applicability of formulas in current use, and, finally, to measure the degree of variation in the amount of heat actually transmitted in different conditions through walls exposed on one side to the outside atmosphere.

The general principle of all the tests was to supply a measured quantity of heat per hour to an insulated enclosure bounded on one or more sides by the wall under test. The difficulties encountered were discussed at length. Owing to war conditions the only structure tested in Series 1 was an old 9-in. brick wall, plastered on the outside with ¾ in. of plaster. Heat was supplied to the interior of the insulated chamber by electrical means automatically regulated. Thirteen experiments were made, the values of K ranging from 0.59 to 0.25. The average was 0.401. The author's note that according to these tests the currently-accepted coefficients are some 25% too low if applied to an old wall. Also to provide for such wind and rain as was experienced in the extreme case, it is necessary to add about 45% to the mean rate of heat loss. General conclusions, however, it is stated, must await a far larger number of observations made in different parts of the country and extending over long periods.

A second series of tests was made to compare various materials of construction in respect of their heat transmission when placed in exactly defined and identical constant conditions. Two exactly similar walls were built of unplastered plain stock bricks, with Flemish bond, 6 ft. square by 9 in. thick, and were designed to be a standard against which all others were to be compared. Between these was clamped a strong double wooden case consisting of two complete hollow squares. All precautions were taken to have them tight. The general mean value of K in 14 independent tests was 0.421.

Owing to the inconvenience and expense attached to the form of test just mentioned a third series was made in which the previously-tested 9-in. wall was retained on one side of the combination and the second plain brick wall was replaced by a 9-in. match-boarded wall. The total amount of heat supplied to the inner chamber was divided between the two walls in proportion to the observed differences of temperature between the two faces of the wall on the two sides, the temperature being taken in the substance of the wall itself. The average mean value of the transmission coefficient of the match-boarded wall was found to be 0.25, which is some 10% below the value given by Rietschel for this combination. It was also brought out that a match-boarded wall 9 in. thick is equivalent approximately to a plain brick wall 21 in. thick.

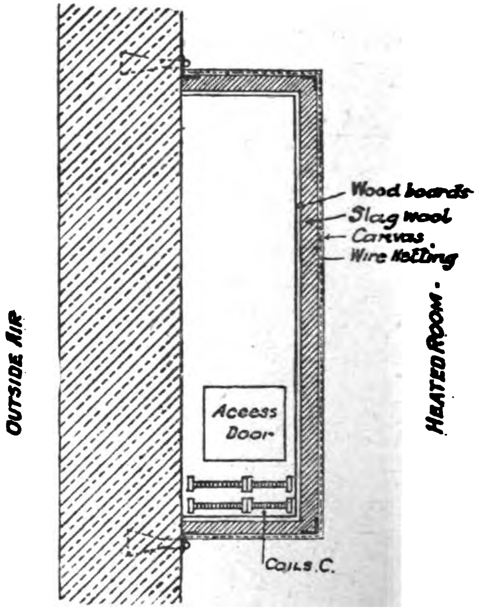


FIG. 1—CONSTRUCTION OF INSULATED CHAMBER USED IN SERIES I.

The method used in Series III was not regarded as altogether satisfactory for general purposes since it involves auxiliary observations on a second structure not actually under test. In a new series that is now under way a further modification of the

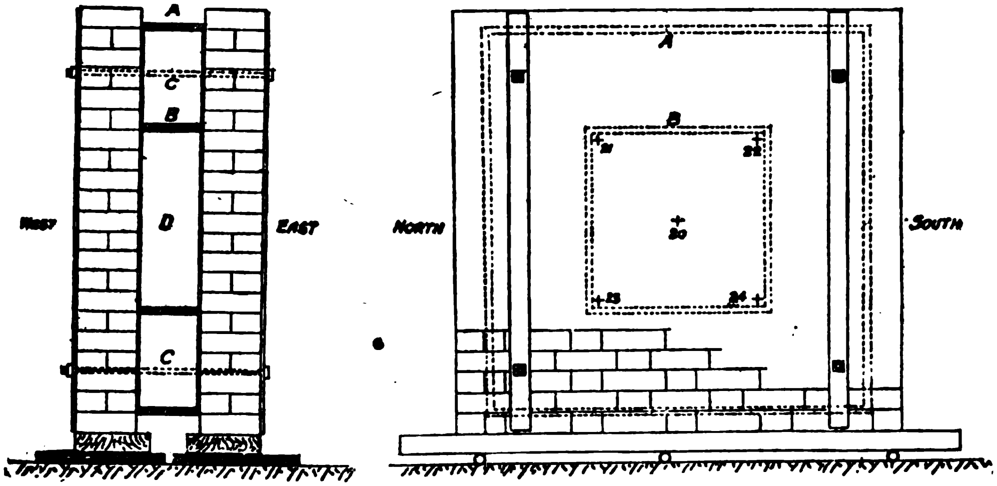


FIG. 2—CONSTRUCTION USED IN SERIES II.
(Numbers show positions of thermo-elements on outside surface of wall.)

"guard ring" method was devised by forming the inner chamber D of Fig. 2 as a completely enclosed case on the principle of Fig. 1. An outer casing was constructed completely enveloping the inner chamber. By this means the auxiliary wall was eliminated. The results of this test will be reported in a supplement to the present report.

Annual Meeting of American Society of Mechanical Engineers.

Dean Mortimer E. Cooley, of the University of Michigan, was elected president of the American Society of Mechanical Engineers, at its annual meeting in New York, December 3-6. Other officers elected were: vice-presidents, F. R. Low, New York; Henry B.

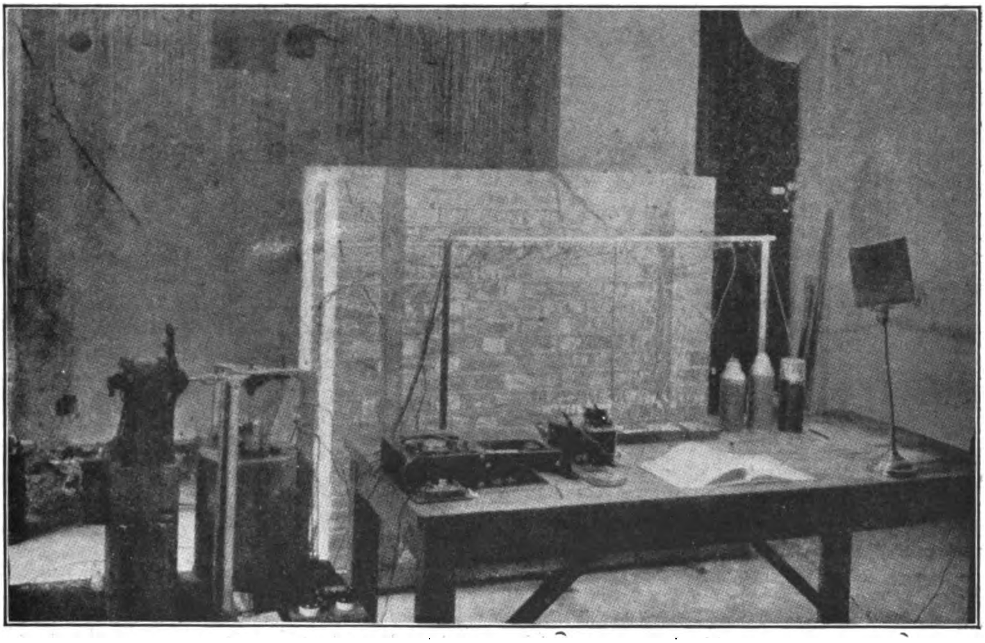


FIG. 3—BRICK WALL UNDER TEST (SERIES II) SHOWING ARRANGEMENT OF THERMOJUNCTIONS.

Sargent, New Haven, Conn.; and John A. Stevens, Lowell, Mass. Managers, Charles L. Newcomb, Holyoke, Mass.; F. O. Wells, Greenfield, Mass.; and Dean C. R. Richards, Urbana, Ill. Treasurer, William H. Wiley, New York.

◆

New Publications.

FIVE WAYS OF SAVING FUEL IN HEATING HOUSES, by Henry Kreisinger, has been published by the Bureau of Mines as Technical Paper 199. These are given as:

1. Of the coals available in your market select the one that requires the least attention in burning.
2. Use an economical method of burning your coal.
3. Keep your house temperature 62° to 65° F., instead of 72° to 75° F.
4. Heat as few rooms as the comfort of your family will permit.
5. Shorten the heating season as much as possible. In firing anthracite the best results, it is stated, are obtained by spreading the coal evenly over the entire fuel bed. The fire should not be allowed to become too low before putting on a fresh firing. A fuel bed 5 to 10 in. thick gives good results. The fire should be disturbed as little as possible.

Briquets when properly made are recommended as very good fuel for house-heating purposes, but the supply is decidedly limited. When burning briquets the fuel bed should be kept 8 to 12 in. thick. The fresh charges should be spread evenly over the grate area. The fire must not be disturbed. Poking breaks the briquets and spoils the fire.

Semi-bituminous coals of the Pocahontas are described as good fuel for heating a house. They are nearly smokeless and make but little soot. For regular firing, the coal can be spread evenly over the entire fuel bed; or, it can be fired like bituminous coal, the fresh charges being placed alternately on one side of the grate and part of the surface of the fuel bed left uncovered. The alternate method should be used if the firings are heavy. The fire keeps better over night if the last firing is heaped to one side of the grate. Good results are obtained with fires 8 to 10 in. thick.

Bituminous coal should be fired by placing the fresh charge on one side of the grate only, leaving part of the surface of the fuel bed uncovered.

If the entire surface of the fuel bed is covered with a heavy charge, the volatile matter from the fired coal does not ignite for a considerable length of time after firing and passes away unburned as tarry, greenish-yellow smoke. The furnace and the flues become filled with the smoke and when the fire finally works its way through the fresh layer of coal the smoke and the gases may ignite with an explosion violent enough to blow the pipes down and fill the house with smoke. This method of firing reduces the amount of soot deposited in the flues so that less frequent cleaning is necessary; it also reduces the heat losses from incomplete combustion, thus directly effecting a saving of coal.

BOILER AND FURNACE TESTING, prepared by Rufus T. Struhm, associate editor of *Power*, is the title of Engineering Bulletin No. 1, issued by the Bureau of Conservation of the United States Fuel Administration. The bulletin takes up the essential elements only and includes an interesting tabulation on "What to Do" and "Why," arranged as follows:

WHAT TO DO.	WHY.
1. Close up all leaks in the boiler setting.	To prevent waste of heat due to excess air admitted.
2. Keep shell and tubes free from soot and scale.	To allow the heat to pass easily into the water.
3. Use grates suited to the fuel to be burned.	To prevent loss of unburnt coal through air spaces.
4. Fire often, and little at a time.	To obtain uniform conditions and better combustion.
5. Cover all thin spots and keep fire bed level.	To prevent burning holes in bed and admitting excess air.
6. Do not allow clinkers to form on side or bridge walls.	Because they reduce the effective area of the grate.
7. Keep the ash pit free from ashes and hot clinkers.	To prevent warping and burning out of the grates.
8. Do not stir the fire except when necessary.	Because stirring causes clinker and is likely to waste coal.
9. Use damper and not ash-pit doors to control draft.	Because less excess air is admitted by so doing.
10. See that steam pipes and valves are tight.	Because steam leaks waste heat and therefore coal.
11. Keep blow-off valves tight.	Because leaks of hot water waste coal.
12. Cover steam pipes and the tops of boilers.	To prevent radiation and loss of heat.

Copies of this bulletin may be obtained from any state administrative engineer as well as from Washington.

HOME HEATING, how to get the most out of a ton of coal is presented in a new bulletin of the Conservation Division of the United States Fuel Administration in which it is stated that from a sixth to a quarter of the coal used in the average home can be saved by proper damper control. Too much draft in the chimney, it is claimed, is responsible for half of the fuel losses in burning coal. Seventeen rules are given on "How to Beat the Chimney and Save Coal," as follows:

1. The secret of coal saving is just enough draft and no more.
2. Keep the cross damper in the chimney pipe as nearly closed as posssible.
3. Soft coal needs some draft through the fire-door, but not much.
4. When you wish to reduce the heat, do not use the damper in the fire-door. It wastes heat and coal. Use the chimney damper.

5. A freshly made fire requires an open chimney damper, but this damper should be closed almost entirely as soon as the fire has gained headway. There is danger of explosion of the gases, however, if the damper is closed before flame appears over the fire.
6. Stop up all cracks in the stove or furnace. They cause waste of heat.
7. Keep your flues and your heating surfaces clean. This is important.
8. Some persons clean their boiler flues and furnace heating surfaces once a year "whether they need it or not." Such people may waste from 50% to 75% of their heat. A quarter-inch layer of soot wastes from 10% to 20% of your fuel.
9. In soft-coal stoves and furnaces the flues should be cleaned twice a week.
10. In hard-coal stoves and furnaces the flues should be cleaned at least once a month.
11. Avoid poking and slicing the fire bed. It causes draft holes and clinkers.
12. Never shake a fire that is low until you have put on a little fresh coal and have let it start to burn.
13. Feed regularly, whether in warm or cold weather. Fill the fire pot. A thin fire wastes coal. Disturb the fire as little as possible.
14. Regulate the fire by the cross damper in the chimney pipe.
15. Put the furnace in repair. Every broken part means a loss of heat.
16. You can lose heat in the basement; you can lose heat throughout the whole house; you can lose heat by the window and the door, *but the chief waste is by the chimney.*
17. Study how to regulate your stove and your furnace, but with all your regulating, *regulate that chimney damper.*

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Housewarming at New Plant of Buffalo Forge Company.

Something unique in the way of a factory opening was carried out by the Buffalo Forge Company on November 8 when a dance was given to its employees before the building was turned over to manufacturing purposes. The new machine shop, for such it is, is of the saw-tooth type of construction, with a number of large galleries supported on heavy steel beams. The floors are of wood, with a hardwood covering, making them, in their new condition, a delightful dance floor.

Nearly 1600 people were present, including employees and their friends. Cider, doughnuts and apples were served and a festive touch was added by the distribution of paper caps of various designs. It can well be imagined that this was a thoroughly democratic gathering inasmuch as the entire force from General Manager H. W. Wendt to the sweepers were there and all report a splendid time. It was particularly interesting to have the dance the day after the first peace rumor was received and just before the final signing of the armistice, so that it was an historical event on that score, as well as being a landmark for the Buffalo Forge Company.

The company is preparing to publish a shop paper as soon as its machine shop is properly organized.

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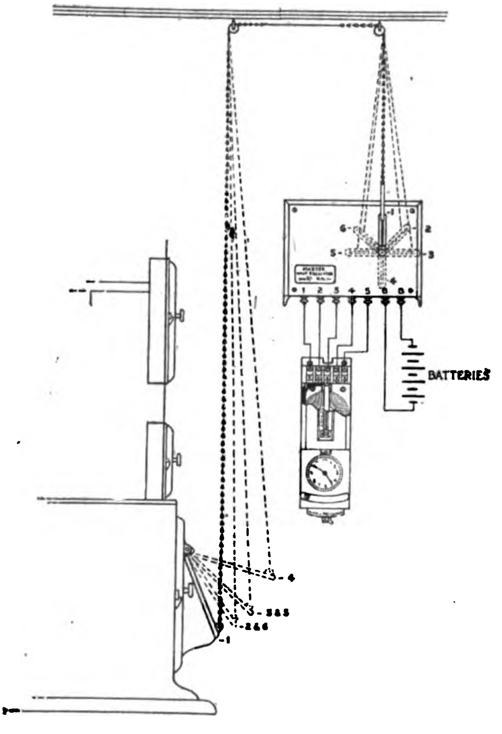
Trade Literature.

MASTER HEAT REGULATOR, made by the Specialty Mfg. Co., St. Paul, Minn., is the subject of a recently-published circular. Its operation is described as different from that of any other heat regulator. The discs No. 1, shown in the illustration, are extremely sensitive to heat and cold. These discs, when expanding, cause the finger 2 to move to the right, and when contracting, to the left. The finger forms an electrical contact upon the segments 3, 4, 5 and 6.. When



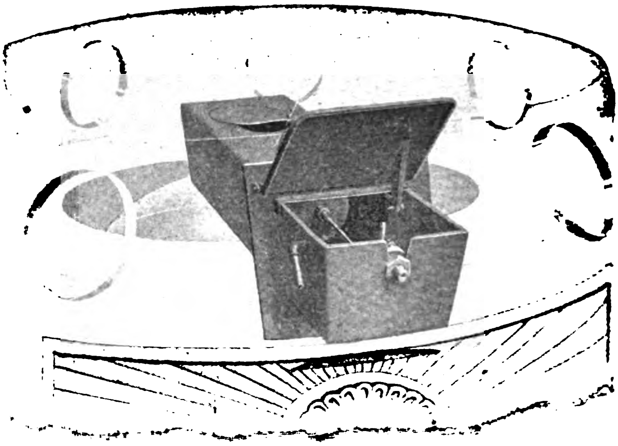
OPERATION OF MASTER HEAT REGULATOR.

in contact with segment 6 the motor causes the draft damper of the heater to close and the check to open wide. Contact with the other segments give varying degrees of control. There is an opening in the case of the thermostat which leaves the contact segments exposed to view. This is in order to indicate the position of the dampers. If by glancing at the thermostat the finger is found at the extreme left of segment 3, it is evident that the draft door is wide open and that the temperature has not come up as it should. This invariably means that the fire needs attention and thus one may determine the condition of the fire without making a trip to the basement.

Excelsior Smokeless Furnace, described as capable of burning soft coal of the cheapest grades without producing objectionable smoke, has been brought out by the Excelsior Steel Furnace Co., Chicago, Ill. It is the subject of a special circular issued by the manufacturers. This heater is of the down-draft type and is furnished in four sizes with casing diameters ranging from 44 in. to 60 in.

EXCELSIOR SMOKELESS FURNACE.

Kraker Simplex Comfort Humidifer, designed for use in connection with a warm-air furnace, is a new device brought out by the Henry Kraker Co., Holland, Mich., and featured in newly-issued circular matter. It is described as completely automatic. It slips through an opening in the canopy of the furnace and rests directly on the dome and radiator. City water flows in at the valve in front and is regulated automatically by the float shown inside. The position of the front cover determines the amount of moisture supplied. The overflow pipe is shown at the left in front. A drain plug, not shown, is supplied with each humidifier, Special emphasis is laid on the way the amount of moisture given off may be regulated. Raising or lowering the outside door operates a damper at the back end of the hood through which the vapor passes into the hot air pipes.



KRAKER SIMPLEX COMFORT HUMIDIFIER INSTALLED.

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Deaths.

James Minot Thayer, for 32 years president of the Thayer Heating Co., Randolph, Mass., and inventor of the Thayer hot-water heater, died at his home in East Greenwich, R. I., October 18. He was 75 years old. Mr. Thayer retired from business about ten years ago.

Henry F. Rosenow, manager of the heating department of Skinner Bros. Mfg. Co., St. Louis, manufacturer of the Skinner Bros. (Baetz patent) system of portable hot blast heating, died at his home in St. Louis, following an attack of typhoid-pneumonia. Mr. Rosenow addressed the heating engineers' society at its meeting last summer in Buffalo on the use of portable air heaters, especially for heating industrial buildings.

Henry T. Richardson, president of the Richardson & Poynton Co., New York, manufacturers of heating boilers and furnaces, died at his home in New York, November 17, after several weeks' illness. Mr. Richardson was 73 years old and had been connected with the business for over fifty years.

HEAT LOSSES FOR VENTILATED ROOMS.

The calculation of heat losses for ventilated rooms involves the omission of the leakage losses and the raising of the exposure factors about 10% as explained in detail on Standard Data Sheet No. 2. Owing to the leakage varying between one-half to two air changes per hour (usually approximating one air change) and the ventilation running from four to twenty air changes per hour (usually approximating six to eight air changes) the leakage in ventilating rooms becomes relatively of minor importance.

In ventilated rooms two conditions may occur: (a) the room may be supplied with 70° air and all the heat losses made up by direct radiation; or, (b), the air may be heated up to whatever degree is necessary to make up the heat losses. In the first instance the system is what is known as a combination "direct-indirect system" with the air supplied purely for ventilation purposes, while in the second case the air is supplied for heating as well as ventilating the system, in this event being usually termed a "hot-blast system" of heating.

Suppose the room taken for example in Standard Data Sheet No. 5-A (May, 1917, issue) is to be ventilated with air at 70° F. so as to give ten air changes per hour. What will be the size of direct radiator, the number of cubic feet of air per minute, the area of the duct and the gross area of the register?

According to the summary of heat losses presented in Standard Data Sheet No. 5-A these losses for a ventilated room will be:

4820	B. T. U. for outside wall and glass
1205	B. T. U. for exposure (increased to 25%)
3630	B. T. U. for inside wall and glass
2520	B. T. U. for ceiling
0	B. T. U. for leakage
12175	B. T. U. for total loss

The 12,175 B. T. U. may be reduced to direct radiator surface, as outlined in Standard Data Sheet No. 13, and the quantity of air per minute may be determined by the use of the formula:

$$\frac{\text{CF} \times \text{C}}{60} = \text{C. F. M.}$$

When C. F. M. is the cubic feet per minute required.
C F is the cubic feet contained in the room.
C is the number of air changes per hour.

Then

$$\frac{2800 \times 10}{60} = 466 \text{ cu. ft. per minute.}$$

At a velocity in the entering duct of, say, 400 ft. per minute, the area of the duct will be 466/400 = 1.16 sq. ft. and the net area of the register, at 250 ft. per minute velocity, will be 466/250 = 1.86 sq. ft., which must be increased about 50% to get the gross area $1.86 + (1.86 \times .50) = 1.86 + 0.93 = 2.79$ sq. ft. gross area.

The heat required for this air may be calculated by the use of the formula:

$$\text{B. T. U.} = \frac{60 \text{ CFM} \times \text{R}}{50}$$

When B. T. U. is the heat required per hour.
C F M the cubic feet of air per minute.
R the rise in temperature in the air.

Then

$$\text{B. T. U.} = \frac{60 \times 466 \times 70^\circ}{50} = 39144 \text{ B. T. U.}$$

This added to the B. T. U. for direct radiation makes a total of

12175	B. T. U. for direct radiation.
39144	B. T. U. for ventilation.
51319	B. T. U. total

HEAT LOSSES IN HOT BLAST HEATING.

If the room is to be heated by the air, as well as ventilated, then the temperature of the air must be raised sufficiently above 70° so that the *surplus* heat in the air will be sufficient to make up the radiation losses of the room. Usually 120° to 140° is considered as the practical limits of heating the air so that when the temperature of the air would have to exceed this it is customary to increase the quantity of air on *account of the heating requirement.*

Under ordinary conditions the quantity of air required for ventilation is more than sufficient to supply the necessary heat and this is found to be the case in the example cited, as is later demonstrated.

The amount of air heated 1° F. by 1 B. T. U. varies slightly at different tempratures and humidities, as is shown in the two right-hand columns of the table giving the "properties of Air" published on Standard Data Sheet No. 9. It is quite usual, however, to consider that 50 cu. ft. may be raised 1° F. with 1 B. T. U. or that 1 cu. ft. may be raised 50° F. by 1 B. T. U. While this is not absolutely correct it is entirely close enough for all ordinary work and facilitates the calculations; when greater accuracy is desired 55 may be substituted for 50.

In the room in question (see Data Sheet No. 5-D) it has been determined that the heat loss is

12175 B. T. U. per hour

and the air per hour is 466 x 60, or

27960 c. f. h.

The increase in air temperature may be calculated from the formula

$$I = \frac{\text{B. T. U.}}{\text{C. F. H.}} \times 50$$

When I is the increase in temperature in degrees above the room temperature and B. T. U. and C. F. H. are the B. T. U. loss and cubic feet of air supplied,—both per hour.

When the increase in air temperaure must be

$$I = \frac{12175}{27960} \times 50 = 21° \text{ plus, say } 22° \text{ F.}$$

As the room temperature is 70° then the air temperature will be 70 + 22 = 92° in order to heat the room.

Proof: During the course of one hour 27,960 cu. ft. of air enter the room. Each cubic foot cools from 92° down to 70° (the room temperature), or 22°. As each cubic foot would have to cool 50° in order to give up 1 B. T. U. in cooling 22° it gives up only 22/50 B. T. U. or 0.44 B.T.U. 27950 cu. ft. x 0.44 B. T. U. = 12,300 B. T. U. supplied, against 12,175 B. T. U. required.

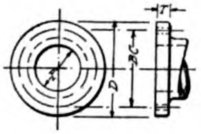
The total quantity of heat is then

60 x 466 x 92/50 = 51200 B. T. U.

if the air is assumed to be heated from zero.

THE HEATING AND VENTILATING MAGAZINE - 1123 BROADWAY-N.Y. CITY.

1915 STANDARD EXTRA HEAVY PIPE FLANGES AND BOLTS.

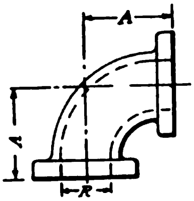


250 LBS. WORKING PRESSURE

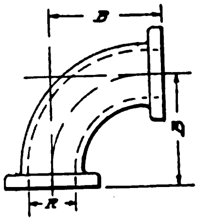
Pipe Size P	FLANGE Dia. D	Thickness T	BOLTS No.	Size	BoltCircle B.C.	BoltHole
1	4½	11/16	4	½	3¼	⅝
1¼	5	¾	4	½	3¾	⅝
1½	6	13/16	4	⅝	4½	¾
2	6½	⅞	4	⅝	5	¾
2½	7½	1	4	¾	5⅞	⅞
3	8¼	1 ⅛	8	¾	6⅝	⅞
3½	9	1 3/16	8	¾	7¼	⅞
4	10	1 ¼	8	¾	7⅞	⅞
4½	10½	1 5/16	8	¾	8½	⅞
5	11	1 ⅜	8	¾	9¼	⅞
6	12½	7 1/16	12	¾	10⅝	⅞
7	14	1 ½	12	⅞	11⅞	1
8	15	1 ⅝	12	⅞	13	1
9	16¼	1 ¾	12	1	14	1⅛
10	17½	1 ⅞	16	1	15¼	1⅛
12	20½	2	16	1⅛	17¾	1¼
14	23	2 ⅛	20	1⅛	20¼	1¼
15	24½	2 3/16	20	1¼	21½	1⅜
16	25½	2 ¼	20	1¼	22½	1⅜
18	28½	2 ⅜	24	1¼	24¾	1⅜
20	30½	2 ½	24	1⅜	27	1½
22	33	2 ⅝	24	1½	29¼	1⅝
24	36	2 ¾	24	1⅝	32	1¾
26	38¼	2 13/16	28	1⅝	34½	1¾
28	40¾	2 15/16	28	1⅝	37	1¾
30	43	3	28	1¾	39¼	1⅞
32	45¼	3 ⅛	28	1⅞	41½	2
34	47½	3 ¼	28	1⅞	43½	2
36	50	3 ⅜	32	1⅞	46	2
38	52¼	3 7/16	32	1⅞	48	2
40	54½	3 9/16	36	1⅞	50¼	2

FITTINGS, EXTRA HEAVY—Pipe Flanges and Bolts. No. 108-A.

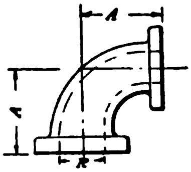
1915 STANDARD EXTRA HEAVY ELBOWS AND REDUCERS.



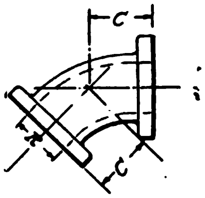
Elbow.



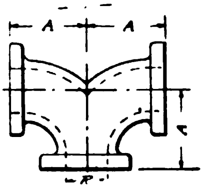
Long-Turn Elbow.



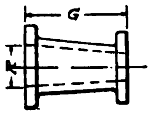
Reducing Elbow.



45° Elbow.



Double-Branch Elbow.



Reducer.

250 LBS. WORKING PRESSURE

Size		Dimensions			Flange	
R	A	B	C	G	Dia.	Thickness
1	4	5	2	—	4½	11/16
1¼	4¼	5½	2½	—	5	¾
1½	4½	6	2¾	—	6	13/16
2	5	6½	3	—	6½	⅞
2½	5½	7	3½	—	7½	1
3	6	7¾	3½	6	8¼	1⅛
3½	6½	8½	4	6½	9	1 3/16
4	7	9	4½	7	10	1¼
4½	7½	9½	4½	7½	10½	1 5/16
5	8	10¼	5	8	11	1⅜
6	8½	11½	5½	9	12½	1 7/16
7	9	12¾	6	10	14	1½
8	10	14	6	11	15	1⅝
9	10½	15¼	6½	11½	16¼	1¾
10	11½	16½	7	12	17½	1⅞
12	13	19	8	14	20½	2
14	15	21½	8½	16	23	2⅛
15	15½	22¾	9	17	24½	2 3/16
16	15½	24	9½	18	25½	2¼
18	18	26½	10	19	28	2⅜
20	19½	29	10½	20	30½	2½
22	20½	31½	11	22	33	2⅝
24	22½	34	12	24	36	2¾
26	24	36½	13	26	38¼	2 13/16
28	26	39	14	28	40¾	2 15/16
30	27½	41½	15	30	43	3
32	29	44	16	32	45¼	3⅛
34	30½	46½	17	34	47½	3¼
36	32½	49	18	36	50	3⅜
38	34	51½	19	38	52¼	3 7/16
40	35½	54	20	40	54½	3 9/16

FITTINGS, EXTRA HEAVY—Elbows and Reducers, Flanged. No. 108-B.